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POLLUTION OF THE INTERSTATE WATERS OF THE GRAND CALUMET RIVER, LITTLE CALUMET RIVER, CALUMET RIVER, WOLF LAKE, LAKE MICHIGAN AND THEIR TRIBUTARIES. PROGRESS EVALUATION MEETING HELD AT CHICAGO, ILLINOIS ON MARCH 15, 1967. VOLUME I

Federal Water Pollution Control Administration
Washington, D. C.

1967

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5285 Port Royal Road, Springfield Va. 22151

PB 230 540

Progress Evaluation Meeting

Volume 1

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In the matter of pollution of the interstate waters of the Grand Calumet River, Little Calumet River, Calumet River, Wolf Lake, Lake Michigan and their tributaries

Wednesday, March 15, 1967

U. S. Department of the Interior
Federal Water Pollution Control Administration
CLEAN WATER

296

SUMMARY
PROGRESS EVALUATION MEETING

FOR THE CONFERENCE IN THE MATTER OF POLLUTION OF THE INTERSTATE WATERS OF THE GRAND CALUMET RIVER, LITTLE CALUMET RIVER, CALUMET RIVER, WOLF LAKE, LAKE MICHIGAN, AND THEIR TRIBUTARIES

(INDIANA-ILLINOIS)

March 15, 1967

The progress evaluation meeting for the conference in the matter of pollution of the interstate waters of the Grand Calumet River, Little Calumet River, Calumet River, Wolf Lake, Lake Michigan, and their tributaries (Indiana-Illinois) was held on March 15, 1967, at the New Federal Building, Chicago, Illinois. The meeting was called by the Conference Chairman, Mr. Murray Stein, U. S. Department of the Interior, Washington, D. C. The purpose of the meeting was to evaluate progress toward pollution control in the waters covered by the conference.

The following conferees representing the State water pollution control agencies of Indiana and Illinois, the Metropolitan Sanitary District of Greater Chicago, and the U. S. Department of the Interior, attended the meeting:

Blucher Poole	Indiana Stream Pollution Control Board Indianapolis, Indiana
Clarence W. Klassen	Illinois State Sanitary Water Board Springfield, Illinois
John E. Egan	Metropolitan Sanitary District of Greater Chicago Chicago, Illinois
H. W. Poston	U. S. Department of the Interior Chicago, Illinois

Murray Stein, Chairman	U. S. Department of the Interior Washington, D. C.

Participants in the meeting included the following:

Vinton W. Bacon	Metropolitan Sanitary District of Greater Chicago Chicago, Illinois
Dwight G. Ballinger	U. S. Department of the Interior Cincinnati, Ohio
Robert J. Bowden	U. S. Department of the Interior Chicago, Illinois
John B. Brough	Inland Steel Company East Chicago, Indiana
Grover W. Cook	U. S. Department of the Interior Chicago, Illinois
Herbert J. Dunsmore	U. S. Steel Corporation Pittsburgh, Pennsylvania
Honorable A. Martin Katz	Mayor, City of Gary Gary, Indiana
James W. Kirkpatrick	Youngstown Sheet and Tube Company East Chicago, Indiana
Perry E. Miller	Indiana State Board of Health Indianapolis, Indiana
Honorable John B. Nicosia, M.D.	Mayor, City of East Chicago East Chicago, Indiana

At the first session of the conference held March 2-9, 1965, the conferees made the following recommendation for municipal waste treatment:

> The Indiana Stream Pollution Control Board, the Illinois Sanitary Water Board, and the Metropolitan Sanitary District of Greater Chicago will institute immediate action in their respective jurisdictions that all sewage receive at least

secondary treatment plus adequate effluent disinfection within one year after the issuance of the summary of the conference. (The conference summary was issued on April 14, 1965.)

Subsequent to the technical session of the conference, held January 4-5, 1966, the conferees adopted water quality criteria for the conference area, and recommended the following time schedule for control of industrial waste discharges:

Preliminary Engineering Plan Documents	December 1966
Final Engineering Plan Documents	June 1967
Construction Complete and Facilities in Operation	December 1968

At this progress evaluation meeting held March 15, 1967, the conferees reached the following conclusions based on meeting discussions:

1. The conferees believe that considerable progress has been made toward abating pollution in the conference area by the municipalities and industries concerned. The conferees recognize that many of the municipalities and industries are making every effort to meet the time schedules and the water quality requirements established at previous conference sessions and that, for the most part, the remedial program is on schedule. Considering the technical complexity of the problem and the concentration of population and industry in the area, these municipalities and industries are to be commended for their achievements.

√

2. The conferees are cognizant of the difficulty that some of the municipalities and industries are having in meeting the time schedules, because of the high degree of water quality and treatment which is required.

3. Recognizing this, and recognizing that the water pollution control agencies involved must establish action programs, the conferees agree that there will be no change in the previously announced time schedules. The present schedule is being maintained to give all the dischargers every opportunity to meet the requirements of the schedule.

4. The conferees have scheduled another progress meeting for September 6, 1967. At that time the question of a reasonable date of compliance will be opened for discussion. At the September 6 meeting the conferees will have the benefit of the action programs developed by the States and the District, and will be in a better position to evaluate the further progress of the municipalities and industries. Adjustments as may be necessary will be determined by the conferees on the basis of the municipalities and industries demonstrating that they have made a bona fide attempt to move forward as rapidly as possible in accordance with the established remedial schedule. Appropriate recommendations in regard to such adjustments will be made by the conferees to the Secretary of the Interior.

DEPARTMENT OF THE INTERIOR

FEDERAL WATER POLLUTION CONTROL ADMINISTRATION

- - - - -

Conference

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In the Matter of:

Progress Meeting in the Matter of Pollution of the Interstate Waters of the Grand Calumet River, Little Calumet River, Calumet River, Wolf Lake, Lake Michigan and Their Tributaries

Wednesday, March 15, 1967
Chicago, Illinois

VOLUME I

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Progress Meeting in the Matter of Pollution of the Interstate Waters of the Grand Calumet River, Little Calumet River, Calumet River, Wolf Lake, Lake Michigan and their Tributaries, convened at the New Federal Building, Adams Street, Chicago, Illinois, at 9:45 a.m., Wednesday, March 15, 1967.

PRESIDING:

Mr. Murray Stein, Assistant Commissioner for Enforcement, Federal Water Pollution Control Administration, Department of the Interior

CONFEREES:

Mr. Blucher Poole, Indiana Stream Pollution Control Board

Mr. Clarence W. Klassen, Illinois State Sanitary Water Board

John E. Egan, Metropolitan Sanitary District of Greater Chicago

CONFEREEES (Continued):

H. W. Poston, Acting Regional Director, Great Lakes Region, Federal Water Pollution Control Administration, Department of the Interior, Chicago, Illinois

PARTICIPANTS:

Grover W. Cook, Chief, Enforcement Section, Great Lakes Region, Federal Water Pollution Control Administration, Department of the Interior, Chicago, Illinois

Robert J. Bowden, Acting Director, Calumet Area Post Action Surveillance Project, Federal Water Pollution Control Administration, Department of the Interior, Chicago, Illinois

Dwight G. Ballinger, Supervisory Chemist, Consultant to Technical Committee, Federal Water Pollution Control Administration, Department of the Interior, Cincinnati, Ohio

Dr. John B. Nicosia, Mayor of the City of East Chicago, Indiana

A. Martin Katz, Mayor of the City of Gary, Indiana

PARTICIPANTS (Continued):

Perry E. Miller, Assistant Director, Division of Sanitary Engineering, Indiana State Board of Health, Indianapolis, Indiana

James W. Kirkpatrick, Manager, Indiana Harbor Works of the Youngstown Sheet and Tube Company, East Chicago, Indiana.

John R. Brough, Director of Air and Water Control, Inland Steel Company, East Chicago, Indiana

Herbert J. Dunsmore, Assistant to Administrative Vice President, Engineering, United States Steel Corporation.

Vinton W. Bacon, General Superintendent, The Metropolitan Sanitary District of Greater Chicago, Chicago, Illinois.

C. Fred Gurnham, Professor and Department Chairman, Illinois Institute of Technology, Chicago, Illinois.

Cornel A. Isahu, Superintendent, East Chicago Sanitary District, East Chicago, Indiana.

Michael J. Nealon, Public Accountant and Real Estate Broker, Gary, Indiana

J. E. Egan, Conferee and President, Metropolitan Sanitary District of Greater Chicago, Chicago, Illinois.

PARTICIPANTS (Continued):

Clarence W. Klassen, Illinois State Sanitary Water Board.

H. W. Poston, Acting Regional Director, Great Lakes Region, Federal Water Pollution Control Administration, Department of the Interior, Chicago, Illinois.

OTHERS IN ATTENDANCE:

A. Anroid, League of Women Voters, 1124 Noyes, Evanston, Illinois

Thomas Atchison, Chief Utilities, Post Engineers, Ft. Sheridan, Bldg. 119, Fort Sheridan, Illinois

Robert J. Austin, Coordinator on Waste Disposal, American Oil Company, 910 South Michigan Avenue, Chicago, Illinois 60680

Richard V. Backley, Attorney - Office of the Solicitor, Department of the Interior, 1915 Quinn Street, Arlington, Virginia

J. S. Baum, Air & Water Conservation Coordinator, Cities Service Oil Company, P. O. Box #300, Tulsa, Oklahoma 74102

Mrs. Richard Bentley, Local Water Resources Chemist, League of Women Voters, 1421 Lake Road, Lake Forest, Illinois

Orville V. Bergren, Secretary, Illinois Manufacturers' Association, 200 South Michigan Avenue, Chicago, Illinois 60604

Mrs. Russell Borgings, Jr., Chairman, Lake Michigan Inter-League Group, League of Women Voters, 1120 Chestnut Avenue, Wilmette, Illinois 60091

Carl Broman, Assistant Superintendent of Utilities, Youngstown Sheet & Tube Company, Indiana Harbor Works, East Chicago, Indiana

OTHERS IN ATTENDANCE:

G. O. Bunch, Works Chemist, Union Carbide Corporation, P. O. Box #750, Whiting, Indiana

J. T. Burke, Product Manager, Nalco Chemical Company, 180 North Michigan, Chicago, Illinois 60601

J. Roland Carr, Regional Editor, Engineering News Record, 645 North Michigan Avenue, Chicago, Illinois 60611

John T. Carroll, Regional Manager - Marketing Government, Worthington Corporation, 4020 West Glenlake Avenue, Chicago, Illinois 60137

D. S. Caverly, General Manager, Ontario Water Resources Commission, 801 Bay Street, Toronto 5, Ontario, Canada

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E. D. Fochtman, Manager, IIT Research Institute, 10 West 35th Street, Chicago, Illinois 60616

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Frederic D. Fuller, Chief Chemist, Federal Water Pollution Control Administration, 1819 West Pershing Road, Chicago, Illinois

OTHERS IN ATTENDANCE:

Diane P. Gavel, Chemist, Federal Water Pollution Control Administration, 1819 West Pershing Road, Chicago, Illinois

Edwin E. Geldreich, Research Microbiologist, Federal Water Pollution Control Administration, Cincinnati Water Research Laboratory, 4676 Columbia Parkway, Cincinnati, Ohio 45226

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James P. Gravenstreter, General Supervisor, Power & Fuel Engineer, U. S. Steel Corporation, Gary Sheet & Tin Works, Gary, Indiana

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OTHERS IN ATTENDANCE:

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Clark N. Johnson, Lake County Water Pollution Council, Route 1, Hobart, Indiana

Mrs. Eileen Johnston, League of Women Voters, 505 Maple Avenue, Wilmette, Illinois

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OTHERS IN ATTENDANCE:

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Charles D. Mitchell, District Engineer, Illinois Division of Waterways, Room 1010, Marina City Office Building, 300 North State Street, Chicago, Illinois 60610

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Jay Newbern, Reporter, NBC News, Merchandise Mart, Chicago, Illinois

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OTHERS IN ATTENDANCE:

Clifford Risley, Jr., Director of Labs, Federal Water Pollution Control Administration, 1819 West Pershing Road, Chicago, Illinois

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Gus Rose, Reporter, Hammond Times, 417 Fayette Street, Hammond, Indiana

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Alan Slingo, Sanitary Engineer, Department of the Navy, Midwest Division, Naval Facilities, Building 1-A, Great Lakes, Illinois 60088

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OTHERS IN ATTENDANCE:

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OTHERS IN ATTENDANCE:

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Thomas Voges, Supervising Chemist, Water and Waste Treatment, Inland Steel Company, 3210 Watling Street, East Chicago, Indiana

Rob Warden, Science Writer, Chicago Daily News, Chicago, Illinois

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Roger S. Whitworth, Assistant Chief Chemist, Federal Water Pollution Control Administration, 1819 West Pershing Road, Chicago, Illinois

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OTHERS IN ATTENDANCE:

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John D. Wolszon, Associate Professor of Sanitary Engineering, Purdue University, Civil Engineering Building, Purdue University, Lafayette, Indiana, 47907

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Thomas Houser, representing U. S. Senator Charles H. Percy of Illinois

PROCEEDINGS

OPENING STATEMENT

BY

MR. MURRAY STEIN

MR. STEIN: May we convene?

This is a meeting of the conferees representing the States of Indiana and Illinois, the Metropolitan Sanitary District of Greater Chicago, and the U. S. Department of the Interior. The purpose of this meeting is to evaluate progress toward pollution control in the waters covered by the conference in the matter of pollution of the interstate waters of the Grand Calumet River, Little Calumet River, Calumet River, Lake Michigan, and their tributaries.

The first conference session was held, under the provisions of the Federal Water Pollution Control Act, on March 2-9, 1965. A technical session of the conference was held on January 4-5, 1966. The conferees then met in executive session on January 31 and February 1, 1966, and the conclusions of the conferees were announced at a public meeting on February 2, 1966.

I think the bare facts of what was done scarcely give the nature of the work that went into this, or the kind of problems that were faced.

The participants in the conference recognize what happened. We did have a report on the southern end of Lake Michigan prepared by the Federal Government in cooperation with the States concerned and the Sanitary Districts. This report was very comprehensive and based on years of study and analyses. We got the views of all the parties concerned put on the record, and we had discussions between the parties and tried to arrive at a conclusion that everyone could agree to.

The Technical Committee represented what I would consider the top technical staff of the Federal Water Pollution Control Administration and Agency, the City of Chicago, the Sanitary District, Illinois and Indiana, and representatives of the steel industry and of the petroleum industry. They met, I think, for a period of nine months to develop requirements and criteria to govern the character and nature of the quality of these waters.

When we look at the committee, I think it is fair to say that I don't think if you scoured the country you would have gotten a more distinguished Technical Committee together to work on the problems.

We did come up with some hard and definite conclusions. These conclusions were put forward and adopted by the conferees. The conclusions are available, if you want to read them.

As one of the reporters said, what was produced was a little telephone book, and that is about right, if you want to look at it this way. There is quite a list of numbers and various constituents which could be pollutants and areas covered, and, like everything else, when you work out the numbers, you come out with the final conclusion. The answer looks simple, but it took a tremendous amount of work to get this done.

I think again we should be proud of what is being done here, because to my mind this is democracy in action in Federal-State-local-industrial relationships coming into play. We have shown that if we work carefully, and through the democratic process, we can arrive at a solution that all parties can adhere to.

We came to recognize in working this out that the problem of water pollution control was so big and so complex that the old conceptual notions of Federal-State-local-industrial-municipal rights in a situation almost became antiquated in dealing with the pollution problems. The job is so big that unless we all work together on this, we are not going to get this job done.

Opening Statement - Mr. Stein

One of the things we realized as we were developing this job, and also on the basis of past experience -- because looking at the table here I think in large part most of the people at this table are old colleagues who have been associated with each other for a decade or two at least, and there is a vast amount of experience on how things get done in water pollution control -- was to have periodic meetings such as this, checking up on the problem.

I think all of us have found that in the past, necessarily, we have had to give realistic time schedules for a clean-up. When such a schedule spreads over a period of two, three, four years or more, unless you have a periodic check-up, you are apt to get some slippage and the program is apt to fail.

In addition to that, I think we all recognize that in water pollution control, we, at least at this head table here, represent public agencies, doing public business in a public manner, and you people are entitled to know just how well we are doing it, or if everyone is doing it, so that you can see if we are on the track to clean up the waters, and how soon we will clean them up.

The parties to this meeting are the Indiana Stream Pollution Control Board, the Illinois State Sanitary Water Board, the Metropolitan Sanitary District of Greater Chicago, and the U. S. Department of the Interior. Participation in this meeting will be open to representatives of these agencies, their invitees, and such persons as inform me that they wish to present statements.

The Indiana Stream Pollution Control Board is being represented by Mr. Blucher Poole, and he is accompanied by Mr. Perry Miller. Mr. Miller was one of the representatives on that famous Technical Committee.

The Illinois State Sanitary Water Board is being represented by Mr. Clarence Klassen, accompanied by Mr. Douglas Morton.

The Metropolitan Sanitary District of Greater Chicago is being represented by Mr. John E. Egan, who is accompanied by Mr. Vinton W. Bacon.

The Federal conferee is Mr. H. W. Poston, who is Director for this region of the Federal Water Pollution Control Administration of the Department of the Interior.

My name is Murray Stein and I am from headquarters of the Federal Water Pollution Control Administration and the representative of Secretary Udall.

At the previous conference sessions the conferees have adopted water quality criteria, programs of remedial action, and time schedules. This meeting is being held to review progress toward compliance with the time schedule set by the conferees at the January 31-February 1, 1966, meeting. That schedule called for preliminary plans by December 1966, final plans by June 1967, and completion of construction by December 1968. In addition, the technical committee will report on progress being made toward coordination of laboratory techniques and procedures, and the Federal Water Pollution Control Administration will submit a report on current water quality conditions in the conference area.

Now a word about the procedures governing the conduct of this meeting. The State and Federal representatives will be called upon to make statements, and they may call upon participants whom they have invited to the meeting. In addition, we may call upon any other interested individuals. At the conclusion of each statement, the conferees will be given an opportunity to comment or ask questions. and at the conclusion of the conferees' comments or questions I may ask a question or two.

A verbatim transcript will be made of the conference by Mr. Al Zimmer. Mr. Zimmer is making this transcript for the purpose of aiding us in preparing a summary of this meeting, and also providing a complete record of what is said here. We will make copies of the summary and transcript available to the agencies represented here. We have found that, generally, for the purpose of maintaining relationships within the States, that the people who wish summaries and transcripts should request them through their water pollution control agency rather than come directly to the Federal Government. The reason for this is that when the conference has been concluded, we would prefer that the people who are interested in the problem follow their normal relations in dealing with the State or city governments rather than the Federal Government on these matters. This has worked successfully in the past, and we will be most pleased to make this material available to these agencies for distribution.

We are in a courtroom, as you know, and this carries with it certain obligations.

1. We have no public address system, so please speak up.

2. Absolutely no smoking, and this includes the adjacent rooms, if you get into them. The judges are very strict about this, and I guess for you, you can be ejected. However, for me, maybe the penalty is a little more stringent, since under the Federal Rules I am an officer of the court, so we are going to be sure there is absolutely no smoking here.

At the present time, I would like to say that we have a representative of Congressman Edward J. Derwinski in the room, Mrs. Georgette Ossello.

Mrs. Ossello, would you stand for one moment, please?

MRS. OSSELLO: Thank you.

MR. STEIN: We did have word, though I am not sure, that Senator Percy might have a representative here. Is he in the room?

MR. HOUSER: Yes; Tom Houser representing Senator Percy.

MR. STEIN: Thank you very much, sir.

With that, we will turn to Mr. Poston for the Federal presentation.

By the way, anyone other than conferees, who wishes to make a statement, please come to the lectern and announce your name and affiliation before you make the statement for the purpose of the record.

In addition, if you have any extra copies of your statement, please give them to the reporter before you start.

Mr. Poston?

STATEMENT OF H. W. POSTON, CONFEREE AND ACTING REGIONAL DIRECTOR, GREAT LAKES REGION, FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, DEPARTMENT OF THE INTERIOR,

CHICAGO, ILLINOIS

MR. POSTON: Thank you, Mr. Stein.

Fellow Conferees, Ladies and Gentlemen:

We are here today to evaluate the progress toward pollution control in the waters of the Calumet area and part of Lake Michigan. Two years have elapsed since the first session of the conference adjourned and attention was focused on the serious situation in the Calumet area. I am optimistic today, much more so than I was two years ago, that these waters can be cleaned up and that they can be kept clean. My optimism is based on two things that have happened in this two-year period: First, we have had momentous Federal and State legislation, on the Federal level the Water Quality Act of 1965 and the Clean Waters Restoration Act of 1966; second, we have seen a marked change in public opinion and there is now overwhelming public sentiment in support of clean water.

Let me elaborate briefly on these points. The requirement establishing water quality standards on interstate waters throughout the country was brought about by the Water Quality Act of 1965. This represents a major departure in water pollution control.

In taking this unprecedented step the Congress said, in effect, that water pollution in this country has gone far enough. The time has come to call a halt. From here on there are going to be standards of quality for all major lakes and streams of this country, and those standards are going to be enforced. This task is now at a crucial stage, and we in the Federal Water Pollution Control Administration are doing everything we can to help the States carry out the letter and spirit of the law. There is much at stake and time is running out. The purpose of the Water Quality Standards Provision is both preventive and curative. Reduced to fundamentals, the object is to preserve those waters that are still clean and to restore to acceptable levels of cleanliness those waters that have become polluted.

The enactment of the Clean Waters Restoration Act of 1966 marked the beginning of a new offensive in America's war on pollution. This landmark legislation makes it quite clear that the Federal Government is prepared to do more than it ever did before to win the battle for clean water. At the same time, the Federal law calls for a comparable all-out effort by the States, by the local municipalities, and by American industry. Although the solution to pollution is not merely opening the flood gates of the Federal Treasury, much greater Federal financial assistance is now available than has ever been before.

The amendment of 1966 contained authorization for Federal grants for research and development. Under the combined sewer program, over $8 million in grants has been awarded to cities for projects they proposed and helped finance to demonstrate new methods of coping with this problem. Fourteen cities and local government districts were awarded grants for demonstration and research projects on advanced waste treatment processes. East Chicago, Indiana, has received grants under the combined sewer program and also under the advanced waste treatment program.

There is also authorization under the 1966 amendment for doubling the amounts of monies given to the State water pollution control agencies for furtherance of their programs. These program grants are to be utilized by the State agencies for the extension of their programs.

The new amendment included new provisions relative to the section dealing with grants for construction of municipal waste treatment plants. The dollar limitation on the amount of Federal funds in the project will be removed on June 30 and the limitations will then be on a straight percentage basis of the total eligible project cost. The new amendment authorizes a maximum appropriation of $450 million for next year and gradually increases the annual authorization until 1971. The exact amounts that will be available each year are determined when Congress rules on the Federal Budget.

One other indication that the Federal Government means business and intends to do its share in the cleanup is supported by the regulations governing tax credit for construction of industrial water pollution control facilities. Water pollution abatement works have been exempt from the suspension of the investment tax credit if certain conditions are satisfied. This means that under certain conditions, industries can deduct up to seven percent of the cost of new waste treatment plant construction from its income tax liability, notwithstanding the general suspension of the investment tax credit. This is certainly an additional incentive for industries to move ahead now in this cleanup program. Already, some firms have sought information concerning the procedures to be followed.

The second significant change, that of the change in public awareness, has simply been a general raising of the sights as to what can and should be done. People in this area have come to realize that something must be done now to protect and improve their heritage of clean water. I think it can be said that the people are now taking the lead in water pollution control. Public debate no longer centers on whether or not we can afford the cost of waste treatment; the question is now, "How soon can the job be done?" From the articles and the accounts of meetings that I have seen, I am convinced that the citizens of this country and their leaders want action now to restore the quality of the waters to an acceptable level of quality and then make sure that they are kept clean.

Most of the problems that existed two years ago still exist today, but many of the problems are on the way toward corrective action. Maximum cooperation and strict adherence to the conference area-wide cleanup by December of 1968 will be required to correct the existing pollution problems. Many cities and industries have already initiated actions recommended at earlier sessions of this conference. The Federal Water Pollution Control Administration is vitally interested in seeing that the waters of the Calumet area, the entire Great Lakes Basin and other basins throughout the country are restored and protected for the future.

I believe that we as conferees, meeting here today, have a great opportunity to map the strategy for victory in this war against water pollution in this area. We have been given the tactical weapons to do this. We have strengthened Federal, and in many instances State legislation, and more is in the offing; and, lastly, we have enthusiastic public support. That is why I said at the outset I am optimistic that these waters can be cleaned up at an early date, and kept clean.

In regard to the status of compliance of Federal installations with the recommendations of this conference, I have asked Mr. Grover Cook, Chief Enforcement Officer of the Great Lakes Region, to give us a report on this, and we will hear from Mr. Grover Cook at this time.

STATEMENT OF GROVER W. COOK, CHIEF, ENFORCEMENT SECTION, GREAT LAKES REGION, FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, DEPARTMENT OF THE INTERIOR, CHICAGO, ILLINOIS

MR. COOK: Mr. Chairman, Conferees, Ladies and Gentlemen:

I am Gover Cook, Chief, Enforcement Section of the Great Lakes Region, Federal Water Pollution Control Administration.

I would like to discuss the progress that has been made since our last meeting.

The United States Coast Guard has developed and installed a package secondary sewage treatment plant of the extended aeration type with effluent chlorination at its Indiana Harbor Light Station.

The Defense Material Supply Depot which is located on Wolf Lake in Hammond, Indiana, discharges all sanitary wastes to septic tank and tile drain field systems. Industrial wastes from this facility consists of cooling waters resulting from air-conditioning and dehumidification equipment used in conjunction with the warehouse facilities. The waste disposal facilities at this installation are adequate and in conformance with the requirements of the conference summary.

The Naval Reserve Training Center in Gary, Indiana, discharges approximately 870 gallons per day of sanitary wastes to a septic tank and tile drain field system; and the T. J. O'Brien Lock and Dam also discharges sanitary wastes generated by the two or three persons at the lock to a septic tank and drain field system.

There are four Nike sites in the conference area which are still under the control of the Federal Government. Several other sites have been phased out. All four of the active Nike sites in the conference area have secondary sewage treatment facilities. However, Site 45 is the only site which provided effluent chlorination. Fifth U. S. Army was directed by its command, Continental Army Command, on June 30, 1966, to provide chlorination facilities at the Nike site in the conference area as soon as possible.

The Fifth Army representative has indicated that the remaining three installations have been delayed pending an evaluation of the facilities recently installed at Site 45.

Adequate effluent chlorination facilities are expected to be in operation by September 1967.

However, we just received a communication this morning from the Department of the Army, that states as follows:

"Site C-45, Gary, Indiana.

"The sand filter bed was rebuilt under a recent contract and a chlorine contact tank and drip-feed method of chlorination installed. The new filter bed did not operate properly due to type of sand used. The contractor was requested to replace the sand under the terms of the contract and he has advised that the existing sand will be removed and new sand installed approximately 30 March 1967. The sample of new sand submitted has been approved by this headquarters as complying with the specifications and will again be checked during installation. The system will be in proper operation in April 1967.

"Sites C-32, Porter, Indiana; C-46, Munster, Indiana; and C-47, Wheeler, Indiana.

"Chlorine contact tanks and drip-feed method of chlorination will be installed in the sewage systems on these sites scheduled as follows:

"a. Designs to be completed in April 1967.

b. Bids for installation to be requested in May 1967.

c. Construction to be accomplished in June 1967."

Then they discuss the kind of laboratory operations that they will perform routinely on these sites.

In the prepared statement, I had a statement that a representative of the Fifth Army would be here to explain why these facilities are not in compliance, but I think this letter explains it fully. I am informed that the representative of the Fifth Army is not present.

MR. STEIN: Mr. Cook, will you read that entire letter, please?

MR. COOK: I read the letter, Mr. Stein. Completely?

MR. STEIN: Yes, please.

MR. COOK: I read everything except the following sentence --

MR. STEIN: Why don't you put it in context?

MR. COOK: All right.

This is addressed the Federal Water Pollution Control Administration, 33 East Congress Parkway, Chicago, Illinois, Attention: Mr. William Riley.

G. W. Cook

"Dear Sir:

"In accordance with your request, the following information is furnished regarding the Army NIKE Sites Sewage Systems in Indiana:

"Site C-45, Gary, Indiana.

"The sand filter bed was rebuilt under a recent contract and a chlorine contact tank and drip-feed method of chlorination installed. The new filter bed did not operate properly due to type of sand used. The contractor was requested to replace the sand under the terms of the contract and he has advised that the existing sand will be removed and new sand installed approximately 30 March 1967. The sample of new sand submitted has been approved by this headquarters as complying with the specifications and will again be checked during installation. The system will be in proper operation in April 1967.

"Sites C-32, Porter, Indiana; C-46, Munster, Indiana, and C-47, Wheeler, Indiana.

"Chlorine contact tanks and drip feed method of chlorination will be installed in the sewage "systems on these sites scheduled as follows:

"a. Designs to be completed in April 1967.

b. Bids for installation to be requested in May 1967.

c. Construction to be accomplished in June 1967.

"Upon the completion of the installation of the chlorination systems, testing will be accomplished as follows:

"a. Biochemical oxygen demand on influent and effluent - twice monthly.

b. Settleable solids on influent and effluent - once weekly.

c. Chlorine residual - twice weekly.

"Sincerely yours,

/s/ WILLIAM P. BANNISTER

LTC, CE

Post Engineer."

That is the end of the letter.

MR. STEIN: Thank you.

MR. COOK: To continue, in regard to federally operated vessels, only one Army Corps of Engineers tug frequents the Calumet Conference Area at the present time. This tug, which is operating in the Calumet River, has been fitted with a macerator/chlorinator, as are all Corps of

Engineers vessels and floating plants, which include dredges, tugs, derricks, etc., in Lake Michigan in accordance with directives from the Office of the Chief, Corps of Engineers.

Considerable attention has been given to the subject of the disposal of dredged material since the conferees last met, and the Department of the Army and the Department of the Interior have reached an agreement on a program and plan for attacking the problem of the disposition of polluted material dredged from harbors on the Great Lakes. I would like to enter into the record the news release which fully describes the agreement and only briefly summarize the provisions today.

I would like to enter into the record at this time, Mr. Chairman, the news release which was recently issued by the Corps of Engineers and the Department of the Interior, and have it included in the record, if we could.

MR. STEIN: Without objection, that will be done.

MR. COOK: Then I would like to summarize what that news release and agreement stated.

(The news release referred to is as follows:

UNITED STATES DEPARTMENT OF THE INTERIOR

NEWS RELEASE

G. W. Cook

DEPARTMENT OF THE INTERIOR

DEPARTMENT OF THE ARMY

For Release March 1, 1967

JOINT PUBLIC STATEMENT BY THE DEPARTMENTS OF THE INTERIOR AND ARMY REGARDING DREDGING ON THE GREAT LAKES

The Department of the Army and the Department of the Interior have reached agreement on a program and plan for attacking the problem of the disposition of polluted material dredged from harbors on the Great Lakes. The agreement covers an interim program, effective immediately for calendar year 1967, and a permanent plan of action to be implemented as rapidly as alternate procedures can be developed, tested and funded. The Federal agencies charged with carrying out the agreement are the Corps of Engineers for the Department of the Army, and the Federal Water Pollution Control Administration (FWPCA) for the Department of the Interior.

By acts of Congress, the Corps of Engineers is responsible for improvement and maintenance of the waterways of the United States in the interest of navigation. These waterways are life-lines of America's growth, industrial might and prosperity and their proper maintenance is an exceedingly important responsibility of the Corps. The Corps of Engineers recognizes that considerable time will be required before complete treatment of municipal and industrial waste will prevent the introduction of pollutants to the waterways. During this time a means must be found to keep the waterways open. Doing so involves dredging of polluted material. The Corps is therefore studying alternate procedures for the disposal of the polluted dredging resulting from these industrial and municipal wastes.

The Department of the Interior (FWPCA) by Congressional acts has the responsibility to enhance quality and value of all water resources and to carry out, in cooperation with State and local governments, a national program aimed at the prevention, control and abatement of water pollution. Additionally, by Executive Order No. 11288, the Department of the Interior shall provide technical advice and assistance to heads of other Departments, who are to provide leadership in the nationwide effort to improve water quality through prevention, control and abatement of water pollution from Federal Government activities.

The two agencies agree that joint effort is required for the development of acceptable alternative disposal means with the ultimate objective of providing leadership in the nationwide effort to improve water quality through prevention, control and abatement of water pollution by Federal water resources projects.

In order to maintain navigation, the Corps of Engineers will proceed with dredging in calendar year 1967 on 64 of the 108 channel and harbor projects in the Great Lakes. A list of these 64 projects is given at the end of this release. While some of these projects are seriously contaminated, disruption of local and national economies would result if dredging were to be deferred this year; and alternate disposal methods cannot be developed and funded in time. Detailed observation and measurement of the polluting characteristics will be jointly conducted by the two agencies during the dredging operations. These observations will include water and material sampling at the dredging site before and after dredging operations and selected sampling en route and at disposal areas with the objective of evaluating the effects of the operations. The analysis of the samples will be done by the Federal Water Pollution Control Administration. These studies will serve to guide plans for alternate methods thereafter.

For the longer range permanent plan, the Corps of Engineers will initiate a pilot program for experimentation in March 1967. An amount of $1 million has been made available for this program during fiscal year 1967, and the President's budget includes $5 million for continuation of the program during fiscal year 1968. The purpose of this program is to develop, with the aid of consultants, the most practicable methods for management of pollution problems related to dredging operations on the Great Lakes that will be consistent with the objectives of cleaning up our rivers and lakes. The Department of the Interior is in agreement with the pilot program and will participate in it. The pilot program will investigate all alternate disposal methods, such as along-shore diked areas, disposal at some distance inland from the shore, and treatment methods, and evaluate pollution abatement results.

Five localities have been selected for institution of the pilot program. The Green Bay project, where scheduled disposal in an away-from-shore land site will permit development of acceptable means of treating the polluted drainage from such an area; the Cleveland project, which has a high pollution index and where a favorable opportunity exists for field experimentation with the dike types; Toledo; and Detroit's River Rouge, where existing near-shore diked areas are in use and where the Toledo site represents an intermediate pollution index; and Great Sodus Bay, where there is a low pollution index. In the Chicago area, the use of onshore disposal areas shows great promise and such areas are being actively explored in connection with the forthcoming maintenance dredging on the Calumet River. The work at these selected areas in 1967 will provide a full-scale test of ways for filtering the liquids draining back into the lake from such areas, as well as confining the solids.

When acceptable alternate methods of dredge disposal have been agreed upon, and at the earliest possible time, the Corps will take appropriate budgetary action to secure the necessary funds. This may require substantial funds programmed over a period of several years.

The Federal Water Pollution Control Administration will contribute to the pilot study effort by providing leadership in the development and implementation of an effective program for measuring the pollutional effects of the materials to be dredged. Skilled personnel, as well as fixed and mobile laboratory facilities of that agency, will be made available to analyze these materials for chemical, biological, physical and other characteristics and thus determine the effectiveness of the various methods proposed.

In carrying forward the nationwide Federal-State-local program to prevent, control and abate pollution in our rivers, lakes and coastal waters, the Department of the

G. W. Cook

Interior will further utilize all of its resources and powers in the support of measures which prevent pollution at the source. By June 30, 1967, the States will submit quality standards and plans for their implementation for approval by the Secretary of the Interior. As State plans of implementation get underway, it is expected that the quantity of polluting materials from municipal, industrial and other sources deposited in navigable waters will be drastically reduced. Thus, the pollutional effects of dredging will be reduced in direct ratio to the success of the nationwide control effort and improved methods of spoil disposal.

The agreement announced today reflects the determination of the two agencies to present an example of what the Federal Government must do to help preserve the incomparable values of the Great Lakes water resources.

Estimated Dredging Requirement - Calendar Year 1967

Lake Ontario

Projects: Rochester Harbor, N.Y., Oswego Harbor, N.Y.; Great Sodus Bay Harbor, N. Y.; Little Sodus Bay Harbor, N.Y.

Lake Superior

Projects: Duluth-Superior Harbor, Minn. & Wis.;

Ontonagon Harbor, Mich.; Big Bay Harbor, Mich.; Cornucopia Harbor, Wis.; Grand Traverse Harbor, Mich.; Keweenaw Waterway, Mich.; Presque Isle Harbor, Mich.; Whitefish Point Harbor, Mich.; Little Lake Harbor, Mich.

Lake Michigan

Projects: Calumet Harbor and River, Ill. & Ind.; Indiana Harbor, Ind.; Green Bay Harbor, Wis.; Two Rivers Harbor, Wis.; Kenosha Harbor, Wis.; Muskegon Harbor, Mich.; Ludington Harbor, Mich.; Frankfort Harbor, Mich.; St. Joseph Harbor, Mich.; Grand Harbor, Mich.; Manistee Harbor, Mich.; Waukegan Harbor, Ill.; Michigan City Harbor, Ind.; Manitowoc Harbor, Wis.; Sturgeon Bay & Lake Michigan Ship Canal, Wis.; Menominee Harbor, Mich. & Wis.; Holland Harbor, Mich.; New Buffalo Harbor, Mich.; Racine Harbor, Wis.; Port Washington Harbor, Wis.; Kewaunee Harbor, Wis.; Pentwater Harbor, Mich.; Saugatuck Harbor, Mich.; South Haven Harbor, Mich.; Charlevoix Harbor, Mich.; Sheboygan Harbor, Wis.; Milwaukee Harbor, Wis.; Maitowoc Harbor, Wis.; White Lake Harbor, Mich.

Lake Erie

Projects: Cleveland Harbor, Ohio; Toledo Harbor, Ohio; Lorain Harbor, Ohio; Sandusky Harbor, Ohio; Fairport Harbor, Ohio; Ashtabula Harbor, Ohio; Black Rock Channel & Tonawanda Harbor, N.Y.; Conneaut Harbor, Ohio; Huron Harbor, Ohio; Erie Harbor, Pa.; Monroe Harbor, Mich.; Rocky River Harbor, Ohio; Dunkirk Harbor, N.Y.; Bolles Harbor, Mich.

A decision respecting Buffalo Harbor will be made at a later date.

Lake Huron & Connecting Channels

Projects: Channels in Lake St. Clair, Mich.; Detroit River, Mich.; St. Clair River, Mich.; Saginaw River, Mich.; Rouge River, Mich.; Alpena Harbor, Mich.; Cheboygan Harbor, Mich.; AuSable Harbor, Mich.)

* * *

MR. COOK: The agreement covers an interim program effective immediately for calendar year 1967, and a permanent plan of action to be implemented as rapidly as alternate procedures can be developed, tested and funded. The Federal agencies charged with carrying out the agreement are the Corps of Engineers for the Department of the Army and the Federal Water Pollution Control Administration (FWPCA) for the Department of the Interior.

In order to maintain navigation, the Corps of Engineers will proceed with dredging in calendar year 1967 on 64 of the 108 channel and harbor projects in the Great Lakes. While some of these projects are seriously contaminated, disruption of local and national economies would result if dredging were to be deferred this year; and alternate disposal methods cannot be developed and funded in time. Detailed observation and measurement of the pollution characteristics will be jointly conducted by the two agencies during the dredging operations. These observations will include water and material sampling of the dredging site before and after dredging operations and selected sampling en route and at disposal areas with the objective of evaluating the effects of the operations. The analysis of the samples will be done by the Federal Water Pollution Control Administration. These studies will serve to guide plans for alternate methods thereafter.

For the longer range permanent plan, the Corps of Engineers has initiated a pilot program of experimentation. The purpose of this program is to develop, with the aid of consultants, the most practicable methods for management of pollution problems related to dredging operations on the Great Lakes that will be consistent with the objectives of cleaning up our rivers and lakes. The Department of the Interior is in agreement with the pilot program and will participate in it. The pilot program will investigate all alternate disposal methods, such as along-shore diked areas, disposal at some distance inland from the shore, and treatment methods, and evaluate pollution abatement results.

Five localities have been selected for institution of the pilot program. In the Chicago area, the use of onshore disposal areas shows great promise and such areas are being actively explored in connection with the forthcoming maintenance dredging on the Calumet River. The work at these selected areas in 1967 will provide a full-scale test of ways for filtering the liquids draining back into the lake from such areas, as well as confining the solids.

When acceptable alternate methods of dredge disposal have been agreed upon, and at the earliest possible time, the Corps will take appropriate budgetary action to secure the necessary funds. This may require substantial funds programmed over a period of several years.

The Federal Water Pollution Control Administration will contribute to the pilot study effort by providing leadership in the development and implementation of an effective program for measuring the pollutional effects of the materials to be dredged. Skilled personnel, as well as fixed and mobile laboratory facilities of that agency, will be made available to analyze these materials for chemical, biological, physical and other characteristics and thus determine the effectiveness of the various methods proposed.

In carrying forward the nationwide Federal-State-local program to prevent, control and abate pollution in our rivers, lakes and coastal waters, the Department of the Interior will further utilize all of its resources and powers in the support of measures which prevent pollution at the source. By June 30, 1967, the States will submit quality standards and plans for their implementation for approval by the Secretary of the Interior. As State plans for implementation get underway, it is expected that the quantity of polluting materials from municipal, industrial and other sources deposited in navigable waters will be reduced in direct ratio to the success of the nationwide control effort and improved methods of spoil disposal.

The agreement between the Department of the Army and the Department of the Interior reflects the determination of two agencies to present an example of what the Federal Government must do to help preserve the incomparable values of the Great Lakes water resources.

In closing I would like to mention to the conferees that at the July 28, 1966, meeting of the conferees you may recall it was suggested that an evaluation of bacteriological sampling and laboratory procedures was to be evaluated. This was done on August 16-18, 1966, by Mr. Edwin E. Geldreich, a specialist with the FWPCA research laboratory in Cincinnati.

I would also like to call to the conferees' attention and to the public the samples that are on the desk in front.

These are samples that were taken from Indiana Harbor on February 14, 1967, at the request of the State of Indiana, and determinations were run for the percentage of organic materials in these samples.

In the course of this, the chemist extracted the oils from this, and the little vials that sit in front of the larger jars -- the larger jars contain the dried dredge material, and actually the wet amount would be about twice as much as in the jars, but these are dried, and the oil was extracted by several means, using several solvents. The oily material is in the small vials in front. I invite you to inspect this at the intermission, if you so desire.

Thank you.

MR. STEIN: Just a moment, Mr. Cook. The floor is open for comments and questions, and I have one right there on your exhibit.

How much of that material did you use to get a vial of oil?

MR. COOK: There is 100 grams in several of these -- I think most of them -- of dried sludge. This would be about probably 200 to 250 grams of wet sludge as it came from the river.

MR. STEIN: And that is comparable to one vial of oil?

MR. COOK: That's right. Yes.

MR. STEIN: All right.

MR. COOK: About 2 percent, I think, is oil in that bottom sample, on the average.

MR. STEIN: Are there any comments or questions?

MR. KLASSEN: I was just wondering, Mr. Cook, can you identify on the map where those samples were taken?

MR. COOK: Yes, I think I can. If I am wrong, I hope somebody will correct me.

It would be right here in the Indiana Harbor turning basin (indicating). I think that is right.

Mr. Poole, probably you can correct it.

MR. POOLE: That is about right. Maybe a few were down to the south.

MR. POSTON: Mr. Bowden is here, the man who collected them.

MR. STEIN: Some people have asked about the procedure that we use at these conferences. Generally speaking, we do not stand on ceremony, but we get the man who does the work to provide the answer.

Mr. Bowden, can you do that?

MR. BOWDEN: Three of the samples were taken in the canal, approximately here, here and here (indicating). The fourth was taken right at the mouth of the canal, where this large black dot is (indicating), and three others were taken in the turning basin here, here and here (indicating).

This is the area that was indicated on the map, that was going to be dredged.

MR. STEIN: Thank you.

Are there any further comments or questions?

(No response.)

MR. STEIN: If not, thank you very much, Mr. Cook.

Mr. Poston?

MR. POSTON: We have Mr. Bob Bowden here today, who will give us a report on the surveillance program that has been carried on. Mr. Bowden is in charge of the activity.

STATEMENT OF ROBERT J. BOWDEN, ACTING DIRECTOR, CALUMET AREA POST ACTION SURVEILLANCE PROJECT, FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, DEPARTMENT OF THE INTERIOR, CHICAGO, ILLINOIS

MR. BOWDEN: Mr. Chairman, Conferees, Ladies and Gentlemen:

I am Robert J. Bowden, Acting Director of the Calumet Area Post Action Surveillance Project. This project was organized, at the request of the States of Illinois and Indiana, in order to assist them in the monitoring of the Calumet area. Its basic function is to determine the quality and changes in quality of the various waters of the enforcement area and to report its findings to the States and to the conferees so that they may evaluate the progress that has been made.

My statement is a summary of two reports on the water quality in the Calumet area. The first covers the six-month period from January 1966 to June 1966 and includes a special section on the beaches which covers the entire 1966 bathing season. The second report covers the final six months of 1966 and includes a comparison with the criteria that have been adopted for the area.

I would like to have each of these reports entered into the record in its entirety.

MR. STEIN: These reports will be entered into the record as read, without objection.

MR. BOWDEN: These reports are based on data from a weekly sampling program at 17 points throughout the area. This data has been supplied on a regular basis to the two States and the Metropolitan Sanitary District. The report on the beaches is based on a twice-weekly sampling program that was carried out at seven beaches during the bathing season. These beaches include Rainbow Beach in Chicago, two Calumet Park Beaches, also in Chicago; Hammond Beach, Whiting Beach, East Chicago Beach and the Hammond, Indiana, Beach on Wolf Lake.

The Chicago beaches sampled met the criteria more often in 1966 than they did in 1965, but when they were polluted, the pollution was just as bad as it was in 1965. The beaches in Indiana, being closer to Indiana Harbor, did not meet the criteria as often as the Chicago beaches.

The Wolf Lake Beach was not subjected to serious pollution and met the criteria 91 percent of the time during the 1966 season.

The most serious source of lake pollution in the

R. J. Bowden

area is the Indiana Harbor and the streams which flow into it, the Grand Calumet River by way of the Indiana Harbor Canal. This drainage system was sampled at six points; one at the Pennsylvania Railroad Bridge over the Grand Calumet River, which is just downstream from the U. S. Steel complex at Gary, Indiana; another at 151st Street on the Indiana Harbor Canal, at Dickey Road on the Canal at the mouth of the Canal, and two points out in the harbor itself.

All of these stations show the same water quality trends. The bacterial counts were approximately one order of magnitude lower during 1966 than during 1965. The concentration of industrial pollution indicators, such as phenols, cyanide, sulphate and iron, were all higher, indicating that more industrial wastes are being discharged than previously.

The Little Calumet River was sampled at Wentworth Avenue, which is near the State line. The water quality of this stream has improved greatly since 1963 but it still does not meet the criteria established for it by the conferees.

The western portion of the Grand Calumet River was also sampled near where it crosses the State line. Most of the flow in this stream is effluent from the Hammond Sewage Treatment Plant and several industries. Before July 1966, the stream was heavily polluted with an average coliform count of 1.5 million per 100 ml. There was a considerable improvement between July and November 1966, the average coliform count during the period being 258,000 per 100 ml or 1/8 of the previous level. In December 1966, however, the coliform counts returned to their previous levels. Other water quality indicators such as nitrogen, iron, phenols and solids followed a similar pattern.

Even in its improved condition the stream did not meet the established criteria.

Wolf Lake is a high quality body of water that is located on the State line. The lake is used extensively for fishing and all types of water recreation. It has been sampled at two points; One on a causeway across the lake at the State line and the other in the lake outlet stream at Carondolet Avenue.

The only serious pollution problem found has been periodic detergent spills which cause foam on the lake and restrict its use as a recreational area.

The criteria were met except for pH, ammonia nitrogen and MBAS, which is a measurement of detergents in the water.

Calumet Harbor has been sampled at three places, on the harbor and two at the mouth of the Calumet River. The natural flow of the river has been reversed so that water flows from the harbor into the river. For this reason the

R. J. Bowden

water quality in the harbor is good. The only major problem is discoloration of the water near the river mouth by iron discharged from the United States Steel Company's South Works.

The four remaining sampling points are water intakes located in the southern end of Lake Michigan. These include the Gary-Hobart Water Intake, the East Chicago Water Intake, the Hammond Water Intake and Dunne Crib, which is an intake for the City of Chicago's South District Filtration Plant.

The waters at Gary-Hobart and Dunne Crib are of high quality and meet the criteria except for ammonia nitrogen. The criteria call for an annual average of not more than 0.02 mg/1 and a single daily value of not more than 0.05 mg/1. The annual average at both points was 0.07 mg/1 with a maximum of 0.28 mg/1 at Gary West and 0.23 at Dunne Crib. Dunne Crib is somewhat protected from pollution from Indiana Harbor by the Calumet Harbor breakwater and Gary-Hobart intake is located far enough away so that it is not severely affected by pollution from the harbor.

The Hammond water intake is most often affected by pollution from the harbor and the East Chicago intake can be affected if the wind is from a westerly direction. At East Chicago the criteria for total phosphates, iron, cyanide, phenols, pH, ammonia nitrogen and color were not met. At Hammond the criteria for total phosphate, iron, dissolved solids, phenols, pH, ammonia, nitrogen and threshold odor were not met.

It is concluded that:

1. The water quality in the Little Calumet River at the State line has greatly improved since 1963 and progress on domestic pollution is still being made. The stream is still polluted and does not meet the recommended criteria.

2. The water quality in the Grand Calumet River at the State line improved considerably during the period July 1966 to November 1966, but deteriorated badly in December 1966. At no time did the stream meet the recommended criteria.

3. The bacterial quality of the Grand Calumet-Indiana Harbor Canal System has improved since 1965 due to chlorination by municipalities and sewer separation by industries.

4. Industrial pollution of the Grand Calumet-Indiana Harbor System has become more severe since the 1965 conference, as evidenced by increased concentrations of iron, phenol, cyanides and other water quality parameters

indicative of industrial waste.

5. Wolf Lake is a relatively clean body of water which meets the recommended criteria except for ammonia, pH and MBAS. Occasional detergent spills are the only significant pollution problem.

6. The water quality of municipal intakes in the inner harbor basins (Hammond and East Chicago) meets some of the criteria, however, because of wastes from Indiana Harbor, does not meet the criteria for phosphates, iron, phenols and dissolved solids.

7. The water quality at municipal intakes in open Lake Michigan waters (Dunne Crib and Gary West) meets the recommended criteria except for ammonia and pH.

R. J. Bowden

(The following material was submitted by Mr. Robert J. Bowden:

STATUS REPORT ON THE
CALUMET AREA POST ACTION SURVEILLANCE PROJECT
DEPARTMENT OF THE INTERIOR

FOR THE PERIOD

JANUARY THROUGH JUNE 1966

ILLINOIS-INDIANA

U. S. Department of the Interior
Federal Water Pollution Control Administration
Great Lakes Region, Chicago, Illinois
October 1966

PERSONNEL

Raymond E. Johnson

Project Director until Sept. 23, 1966

Robert J. Bowden

Sanitary Engineer

Acting Director after Sept. 23, 1966

David E. Vaughn

Sanitary Engineer until Aug. 23, 1966

Harold A. Bond

Microbiologist until Sept. 2, 1966

Diane P. Gavel

Chemist

Anne Byrne

Microbiologist after Sept. 19, 1966

Joseph V. Slovick

Aquatic Sampler - Hydraulic Technician

William J. Degutis

Aquatic Sampler - Monitor Technician

R. J. Bowden

Daniel Chorowicki

Aquatic Sampler

Lillian Ehlert

Secretary

INTRODUCTION

Part I of this report presents an evaluation of the progress made toward improved water quality in the Calumet Area as of June 30, 1966. This evaluation is based on the results of the sampling program of the Federal Water Pollution Control Administration Calumet Area Post Action Surveillance Project. The waters reported on include the Grand Calumet River, the Indiana Harbor Canal, Indiana Harbor, the Little Calumet River, Wolf Lake and its outlet and Calumet Harbor.

Part II is an evaluation of the bacteriological quality of eight beaches on Lake Michigan and one on Wolf Lake which are located within the study area. This evaluation covers the entire 1966 bathing season and is based on the surveillance project's own sampling program, data provided by the Chicago Park District and data provided by the Indiana Board of Health.

Part III is a report on the status of the surveillance project and its future prospectus.

The cooperation provided by the Indiana Stream Pollution Control Board, the Illinois Sanitary Water Board, the Metropolitan Sanitary District of Greater Chicago, the United States Coast Guard and others in supplying valuable information and facilities is gratefully acknowledged.

Background

Authority and Organization

A conference on pollution of the interstate waters of the Grand Calumet River, Little Calumet River, Calumet River, Wolf Lake, Lake Michigan and their tributaries, called by the Secretary of Health, Education, and Welfare under the provisions of Section 8 of the Federal Water Pollution Control Act (33 USC 466 et seq.) was held in Chicago, Illinois, March 2-9, 1965.

Paragraph No. 14 of the Conclusions and Recommendations of the Conferees for this conference provided that "Surveillance will be the primary responsibility of the Indiana Stream Pollution Control Board, the Illinois Sanitary Water Board and the Metropolitan Sanitary District of Greater Chicago. The Department of Health, Education, and Welfare will make available a resident technical group and visiting groups of experts which will assist the State agencies and the Metropolitan Sanitary District of Greater Chicago at such time as requested by them."

The State of Indiana, on April 6, 1965, and the State of Illinois, on April 16, 1965, requested an extensive sampling program by the Federal Government to monitor the quality in the Calumet Area. The Metropolitan Sanitary District has not formally requested a sampling program, but has requested laboratory assistance in the analysis of samples they have collected and in special studies they have conducted on chlorination of the effluent from their sewage treatment plant. The Calumet Area Surveillance Project was organized in the latter part of June 1965 to fulfill the requirements of paragraph No. 14 and the requests of the States.

On January 1, 1966, the Federal Water Pollution Control Administration was created within the Department of Health, Education, and Welfare and incorporated the surveillance project.

On May 10, 1966, the Federal Water Pollution Control Administration was transferred from the Department of Health, Education, and Welfare to the U. S. Department of the Interior.

Purpose and Scope

R. J. Bowden

The purpose of the Calumet Area Surveillance Project is to assess the progress in the abatement of pollution in the conference area in cooperation with appropriate State and local agencies. This is being accomplished through a sampling program to monitor the water quality at various locations within the conference area and a series of electronic water quality monitors to continuously monitor the water quality at selected key points in the basin. Stream flow measurements are being made so that laboratory analyses in milligrams per liter can be converted to pounds per day. The information obtained through Federal, State and local sampling programs and the information furnished by the industries to the State or other responsible agencies on the quality and quantity of their waste flows are evaluated.

Reports are prepared and presented to the conferees and reconvened conferences on the current water quality and the progress toward abatement of the pollution.

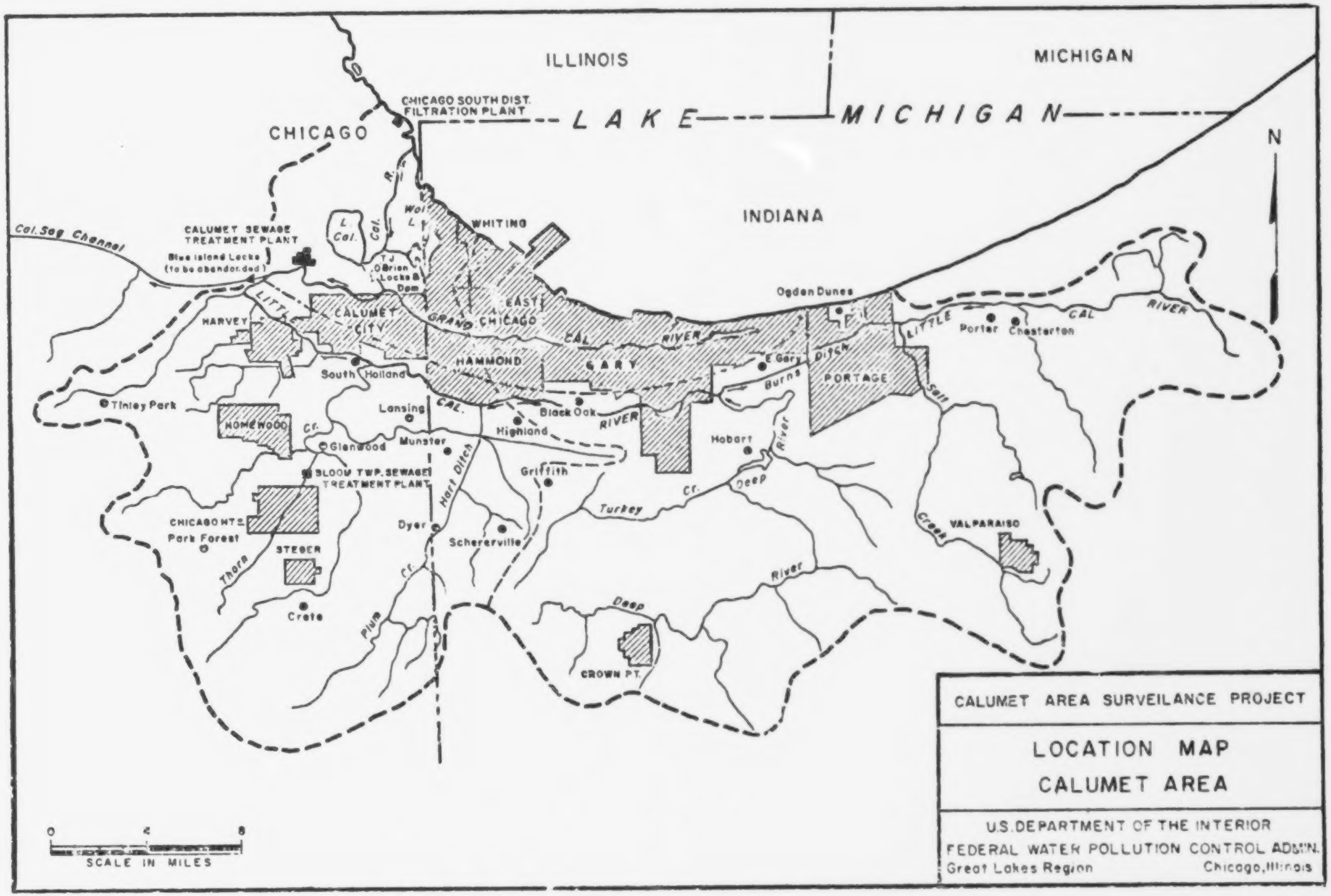
Description of Area

The Calumet area is a flat plain located at the southern end of Lake Michigan and includes the Calumet-Little Calumet River system, the Grand Calumet-Indiana Harbor Canal system, Wolf Lake and its outlet. It includes approximately

742 sq. miles and forms a part of the Continental Divide between the Mississippi River Basin and the Great Lakes-St. Lawrence River Basin. Approximately 60% of the area drains to Lake Michigan and the remaining 40% drains to the Mississippi River by way of the Illinois River. Despite this fact, the area is not well drained. There are large, marshy, low-lying areas which are subject to flooding during and after heavy rainfalls. The streams are sluggish and meandering except where they have been artificially maintained and/or supplemented by industrial or municipal waste flows.

The Grand Calumet and the Little Calumet Rivers both traverse the Divide. On the Grand Calumet the Divide is normally located at the Hammond, Indiana, sewage treatment plant outfall. Approximately two-thirds of the effluent flows west into the Calumet River in Illinois and one-third flows east to the Indiana Harbor Canal and Lake Michigan. Rainfall and lake level conditions can cause the Divide to shift to either the east or the west.

The location of the Divide on the Little Calumet River is not definite and varies over a distance of several miles in the vicinity of Highland, Indiana. The western portion flows to the Cal-Sag Channel in Illinois, which connects the system to the Illinois River. The eastern



CALUMET AREA SURVEILANCE PROJECT

LOCATION MAP
CALUMET AREA

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN.
Great Lakes Region Chicago, Illinois

portion flows to Lake Michigan by way of Burns Ditch, which discharges to the lake near Ogden Dunes, Indiana.

Flow in the Calumet River is controlled by the O'Brien Lock and is directed from Lake Michigan to the Cal-Sag Channel except during periods of heavy flooding or unusually low lake levels.

The Indiana Harbor Canal, which was completed in 1903, connects the Grand Calumet River to Lake Michigan. The Grand Calumet River east of the Hammond Sewage Treatment Plant outfall is tributary to Lake Michigan through the canal.

Wolf Lake is located on the Illinois-Indiana State line between Chicago, Illinois, and Hammond, Indiana. The original outlet from Wolf Lake to Lake Michigan has been blocked and an outlet to the Calumet River in Chicago has been constructed. The City of Hammond maintains a park which occupies most of the Indiana shoreline of the lake. This park and the lake are extensively used for recreation. The Illinois portion of the lake is a part of the Wolf Lake Conservation Area.

Cities and Industries

The major population centers in the area are East Chicago, Gary, Hammond and Whiting, in Indiana; and

Calumet City, Chicago Heights and a part of the south side of Chicago in Illinois. The area is highly industrialized. There are ten major steel mills including the United States Steel Corporation's Gary Works, Gary Sheet and Tin Mill, Youngstown Sheet and Tube Company, and Inland Steel Company in Indiana and United States Steel's South Works, the Wisconsin Steel Company, the Interlake Iron Corporation, the Republic Steel Corporation and the Acme Steel Company in Illinois. There are five petroleum refineries including the American Oil Company, the Cities Service Petroleum Company, the Mobil Oil Company, and the Sinclair Refining Company, in Indiana, and the Clark Oil and Refining Company in Illinois. Other industries include Lever Brothers, Union Carbide Chemical, I. E. DuPont, M. & T. Chemicals, American Maize and a large number of smaller concerns.

These industries are located in three major groups. One group is concentrated along the Calumet River in Illinois. Another is along the Indiana Harbor Canal and the third is in Gary, Indiana, and discharges to the headwaters of the Grand Calumet River. These three groups make the Calumet Area one of the most important industrial centers in the Nation.

DESCRIPTION OF PROGRAMS

Stream and Harbor Sampling Program

During the period January to June 1966, thirteen stream and harbor stations were sampled on a weekly basis for chemical and microbiological quality determinations. Nine of these were sampled during the entire period. The remaining four are lake stations that require a boat for sampling. These were not sampled until March 31, 1966, due to ice and inclement weather on the lake. The results of this program are presented in Part I of this report.

Beach Sampling Program

Sampling on seven beaches in the area was initiated on May 31, 1966, and continued on a twice weekly basis until September 15, 1966. Six of these beaches are located on Lake Michigan and one on Wolf Lake. Five of the beaches were sampled at their mid-points in water approximately four feet deep. Two beaches, Rainbow Beach and Calumet Inner Beach, were sampled at two points each at the one-third points. Samples were collected on Tuesday and Thursday of each week and analyzed for total coliforms, fecal coliforms and fecal streptococci. This program was coordinated with the beach sampling programs of the Chicago Park District and the Indiana State Board of Health and data was distributed freely among the agencies. The results of the beach sampling program for the 1966 season are presented in Part II of this report.

Hydraulic Measurements Program

No gauging stations are maintained by the U. S. Geological Survey in the Grand Calumet-Indiana Harbor Canal drainage system. Therefore, six continuous water level recorders have been installed on these streams. The streams are being gauged at these stations so that rating curves can be developed for each station. The stage vs. discharge relationship in the lower reaches of the Indiana Harbor Canal is seriously distorted by fluctuations in the lake level. For this reason no stage recorders have been installed in this area. Special flow area and velocity studies are planned in order to determine the effect of the numerous industrial outlets in the area.

Information provided by the U. S. Geological Survey and the Metropolitan Sanitary District will be used as the basis for flow calculations on the Little Calumet River, the Calumet River and Wolf Lake Outlet.

The purpose of this program is to develop flow data for all of the sampling stations in the surveillance area except for those located in Lake Michigan.

Automatic Monitoring Program

Many operations of the industries in the basin require discharge of wastes on a batch basis, and wastes from these tanks may be dumped at any time of the day, week, or month, depending on the needs of the industry. These discharges and accidental spills of oil or other pollutants could pass into Lake Michigan or down the Illinois River unobserved by a once-a-week sampling program.

During November 1965 an automatic water quality monitoring station was installed in Indiana Harbor at the East Breakwall Inner Light. This installation continuously records the dissolved oxygen, pH, conductivity and temperature of the water flowing past this point into Lake Michigan. A complete report on this installation was given in the report covering the period June through November 1965.

A second monitor was installed during August 1966 to measure the same parameters at the mouth of the Calumet

River. This monitor replaces the semi-portable, temporary monitor that had been located there during 1965. A complete report on this new installation will be presented in the report for the June-December 1966 period. It is planned to mount the semi-portable monitor in a boat and use it for profile studies of the various streams in the area. This procedure should be of value in pinpointing specific sources of wastes in the area.

An automatic sampling device will be installed on each monitor as soon as it becomes available. This device will automatically collect a sample when one or more of the parameters being monitored exceed certain limits.

Next year it is planned to install two additional monitors and a central control station to which all the data will be continuously telemetered. One monitor will be located at Wentworth Avenue on the Little Calumet River and will monitor the quality of the water flowing across the State line at this point. The other will be located on the Grand Calumet River below the industrial complex at Gary, Indiana. This will monitor pollutants discharged to the headwaters of the stream and may enable warnings to be given to downstream uses of the approaching pollution. Eventually a network of six monitors is planned for the area. This network will be coordinated with the monitoring systems of the States of Indiana and Illinois and of the Metropolitan Sanitary District.

Biological Surveying Program

The kinds and numbers of aquatic plants and animals inhabiting a particular body of water and the stream or lake bottom beneath it, reflect the quality of the water that prevails in the area. Some organisms are capable of withstanding polluted conditions and will multiply rapidly when competition from other less tolerant organisms is eliminated. These pollution-tolerant organisms include sludgeworms, bloodworms, leeches, blue-green algae and pulmonate snails. In an unpolluted environment the number of these organisms is restricted by competition from other species but when the other species are killed off by pollution they multiply rapidly. Therefore, the continuous or sudden introduction of toxic wastes, settleable solids or oxygen-consuming materials alters the composition of the benthic population. A balanced population is not restored immediately upon the return of optimum water quality because of the lengths of the life cycles of those organisms which vary from weeks to years. This fact makes it possible to detect slugs of pollution that have passed through a sampling station.

Fifteen substrate samples of the Dendy type were made and used in the waters of the Calumet Area during October through November 1965 on an experimental basis. The results obtained from these samples have been compared with the more standard dredge samples that were taken at the same time. The results of this experiment are presented as an appendix to this report. Further experimentation with this sampling method is planned next spring.

Conclusions

1. The water quality in the Little Calumet River at the State line has been improved considerably since 1963 but still does not meet the proposed criteria. There has been no significant change in water quality since 1965.

2. The microbiological quality of the Grand Calumet River-Indiana Harbor Canal system has been improved considerably since 1965 due to separation of industrial and sanitary wastes. It is still not at an acceptable level, however.

3. The industrial pollution problem of this system has not improved since 1965 and has, if anything, become slightly worse. This is due to the fact that the

industrial waste treatment facilities of most of the industries have not been completed and production in the area has increased.

4. Wolf Lake is a relatively clean body of water. The only pollution problem of any significance is occasional spills of MBAS from Lever Brothers Company and possibly batches of cyanide from an unknown source. Most of the water quality criteria for this lake are being met.

5. The beaches in 1966 met the criteria for bathing beaches a greater percentage of the time in 1966 than in 1965, but when they were polluted the pollution was just as bad in 1966 as it was in 1965.

PART I - WATER QUALITY

Stream and Harbor Sampling

Thirteen stream and harbor stations were sampled for bacteriological and chemical quality during the first six months of 1966. Samples were collected once each week except that stations requiring a boat could not be sampled during severe weather. All stream stations were sampled at mid-stream except for Stations 6 and 11, which were sampled at the water quality monitor intake. The samples for bacteriological analysis were taken at a depth of 6 inches to 1 foot. The samples for chemical analysis were taken at mid-depth or 10 feet in the case of navigable channels.

All of the samples were immediately preserved and/or iced where required in accordance with procedure established in "Standard Methods for Examination of Water and Wastewater, 12th Edition, 1965." Laboratory analysis on samples subject to deterioration was initiated on the same day they were collected.

Bacteriological analyses were performed in accordance with "Standard Methods." Total coliform, fecal coliform and fecal streptococci counts were made on each sample. The results of these analyses are presented in Figures I-1 through I-6. All values in Figures I-1 through I-6 and in the following discussion are the number of organisms per 100 ml.

Chemical analyses were performed in accordance with methods agreed upon at the Calumet Area Enforcement Laboratory Directors' Meeting held on April 29, 1965. The six laboratory conferees discussed the methods to be used by all laboratories concerned with the Calumet Area Surveillance activities.

Grand Calumet River at Pennsylvania R. R. Bridge (Station 1)

R. J. Bowden

This station is located upstream of the Gary Sewage Treatment Plant where the bulk of the flow is industrial waste from the United States Steel Company's complex at Gary, Indiana, which has waste discharges located approximately two miles upstream.

The nearest station for flow data is located four-tenths of a mile downstream at Industrial Avenue. This station is below the outfall of the Gary Sewage Treatment Plant; therefore another station, approximately one mile upstream at Bridge Street, has been gauged. The Pennsylvania R. R. bridge is not suitable for a gauging station. Flows at the Pennsylvania R. R. bridge should be somewhat higher than at Bridge Street because there is one tributary which drains an area north of the river between them. The average of seven gaugings at Bridge Street between October 1965 and June 1966 is 652 cfs.

As shown in Figures I-2, I-4 and I-6, the bacterial counts for January-June 1966 have dropped considerably from the levels of June-November 1965. Total coliforms varied from 130,000 to 100 with an average of 22,500 and a median of 6,000. All of these values, while still high, are less than 10% of their 1965 levels. Fecal coliforms varied from 40,000 to less than 10, with an average of 5,700 and a median of 1,900. These values are also about 10% of their 1965 levels. Fecal streptococci showed a similar but less dramatic decrease, varying from 4,000 to 10, with an average of 740 and a median of 410, which are all less than 50% of their 1965 levels.

The fact that the 1966 data includes such cold months as January, February and March, while the 1965 data covers June through November, is responsible for a part of this drop.

The fact that a large amount of cooling water is discharged to the stream tends to minimize this effect, however. The minimum temperature during 1966 was 10°C.

The major part of this decrease is due to the separation and diversion of sanitary wastes from the U. S. Steel complex at Gary to the Gary sewage treatment plant. Although there has been a considerable improvement in the bacteriological quality of the stream, it still does not meet the recommended criteria for the Grand Calumet River, which calls for a maximum total coliform count of 5,000, except during periods of high runoff.

Further evidence of the reduction in domestic pollution is the increase in the dissolved oxygen which is shown in Table I-1. The maximum DO increased from 6.0 mg/1 in 1965 to 9.0 mg/1 in 1966, and the median increased from 3.7 mg/1 to 5.8 mg/1. Although a part of this difference is due to the colder season covered by the 1966 data, some of it must be attributed to the reduction in sewage pollution. The effect of the cooling water and the fact that there was no corresponding rise in BOD support this view.

There is still a serious industrial waste problem at this site. The median pH of 6.9 remained the same in both 1965 and 1966. On June 3, 1966, however, the pH was 3.60 and the sulphates concentration was 200 mg/1, compared with a normal range of 50 mg/1 to 70 mg/1. This data indicates that spent pickling liquor was discharged from one or more of the upstream steel mills. A deep well injection disposal system for this waste was due to go into operation during July 1966. It is hoped that this will eliminate discharges of this nature.

Phenol rose from a mean of 28 ug/1 to a mean of 126 ug/1. Some of this increase probably is due to the effect of the colder weather which tends to reduce their rate of degradation, but in view of the large amount of cooling water which tends to maintain the temperature, it must be assumed that much of this increase is due to an increased amount of phenol being discharged to the stream. One sample in June 1965 contained 11.8 ug/1 phenols and five June 1966 samples averaged 45.4 ug/1. Suspended solids also increased appreciably from an average of 44 mg/1 in 1965 to an average of 247 mg/1 in 1966. Cyanides appear to have increased from an average of 0.03 mg/1 to 0.32 mg/1, but the 1965 data for cyanides is undoubtedly too low. During December 1965 the analysis for cyanide was changed in order to eliminate interference which was caused by other pollutants.

Oil has been reported on the surface each time the station has been sampled since the beginning of the surveillance, in spite of the fact that an oil skimmer is located a few feet upstream from the sampling point.

The reasons for these increases in industrial waste are not clear, but it is noted that a new basic oxygen steel shop was opened during December 1965.

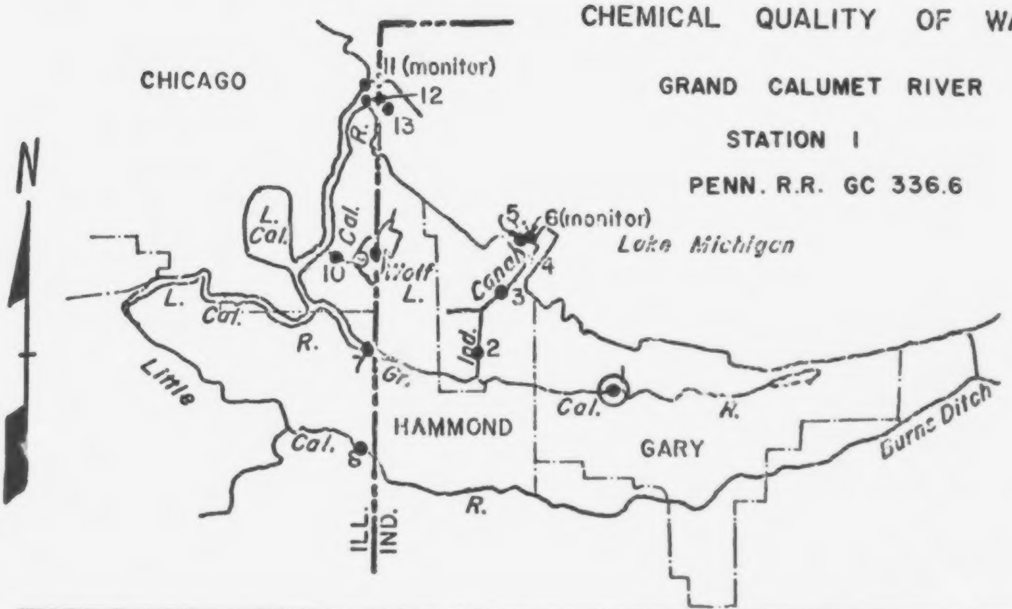
TABLE I - 1

CHEMICAL QUALITY OF WATER

GRAND CALUMET RIVER

STATION I

PENN. R.R. GC 336.6



Parameter		June 1965-Nov.1965				Jan. 1966-June 1966			
		Max	Min	Mean	Median	Max	Min	Mean	Median
pH		7.2	4.1	6.7	6.9	8.0	3.6	6.8	6.9
DO	mg/1	6.0	1.1	3.6	3.7	9.00	2.50	5.83	5.80
BOD	"	17	5.7	9.8	8.5	16	2.4	8.6	8.6
COD	"	59	7.9	32	39	43	21	28	27
Sulphates	"	186	29	56	49	200	37	66	56
NH_3-N	"	3.7	0.87	1.5	1.6	4.4	1.5	2.4	2.4
NO_2-NO_3 N	"	7.5	0.32	1.4	0.69	11.3	0.18	0.89	0.55
Org-N	"	7.3	0.06	1.3	1.6	1.2	0.0	0.40	0.40
Total PO_4	"	0.93	0.10	0.28	0.24	0.58	0.11	0.26	0.23
Total Sol. PO_4	"	0.32	0.00	0.08	0.06	0.41	0.02	0.19	0.17
Total Iron	"	23	2.7	7.9	6.6	48	3.2	9.7	5.8
Phenol	ug/1	100	0	28	22	320	18	126	129
Cyanide	mg/1	0.19	0.00	0.03	0.01	0.63	0.00	0.32	0.39
Sus. Solids	"	70	26	44	59	125	30	67	68
Dis. Solids	"	365	170	245	235	380	205	247	235
Chlorides	"	-	-	-	-	40	14	20	18
MBAS	"	-	-	-	-	0.28	0.07	0.14	0.12
Conductivity	umho/cm	-	-	-	-	765	308	399	380
Temperature	°C	31	15	24.6	26	28	10	16	16

1965 data based on 19 samples except for: cyanide(17): susp.solids(10); dis. solids(9).
1966 data based on 26 samples except for: chlorides(19); ABS(19);conductivity(19).

Indiana Harbor Canal at 151st St. (Station 2)

This station was established in order to determine the quality of the water in the canal where it is formed by the two portions of the Grand Calumet River. This station is affected by effluent from the Gary, Hammond and East Chicago sewage treatment plants as well as the effluent from a number of industries on the Grand Calumet River. The Gary and East Chicago sewage treatment plants are chlorinating their effluent at present.

The total coliform count varied from 6,000 to 270,000, with an average of 55,000 and a median of 46,000. These values are considerably below the June-November 1965 values which averaged 1,500,000, with a maximum of 4,300,000 and a minimum of 33,000, but are still very high and indicate considerable sewage pollution.

The fecal coliform count varied from 500 to 150,000, with an average of 16,500 and a median of 6,800. The fecal streptococci count varied from 50 to 16,000, with an average of 2,810 and a median of 1,200. Each of these parameters are lower than they were in 1965, but they still indicate that a serious pollution problem still exists.

The counts at this station are considerably higher than the counts at the Pennsylvania R. R. bridge (Station 1).

This could be due to flow from the Hammond sewage treatment plant or flow from the industries on the Grand Calumet River.

The reduction in the counts between the 1965 data and the 1966 data is probably due to a combination of colder weather in 1966 and a reduction in domestic pollution by the industries. This station is also affected by cooling water discharges which reduce the effect of the colder weather. The minimum water temperature during 1966 was 10°C.

The continuation of the sewer separation programs by the industries and the completion of chlorinating facilities by the sewage treatment plants should bring a considerable improvement in the microbiological quality of the stream at this station.

The level of industrial pollution appears to be rising. The average sulphates concentration rose from 56 mg/l in 1965 to 88 mg/l in 1966; the average iron concentration rose from 2.4 mg/l to 5.5 mg/l; the average cyanide concentration rose from 0.03 mg/l to 0.19 mg/l; the average suspended solids content rose from 30 mg/l to 61 mg/l; and the average phenol concentration rose from 19 ug/l to 107 ug/l.

The maximum sulphate concentration of 138 mg/l occurred on June 3, 1966, and can be traced to discharge of spent pickling liquor from the steel complex at Gary, Indiana. The pH at this station had risen to 6.5 from the 3.6, found at Station 1, but is still the minimum pH found at Station 2. Much of the acid was probably neutralized by effluent from the Gary sewage treatment plant, which is located just below Station 1. Evidence of this slug of pickling liquor was also found at the next downstream station at Dickey Road, where the sulphate concentration was 122 mg/1, which is the maximum, and the pH was 6.6, which is below the average of 6.9.

This increase in the level of industrial pollution is due to the increased production in the area. Many of the industries are due to submit plans for additional waste treatment facilities to the Indiana Stream Pollution Control Board by December 1, 1966.

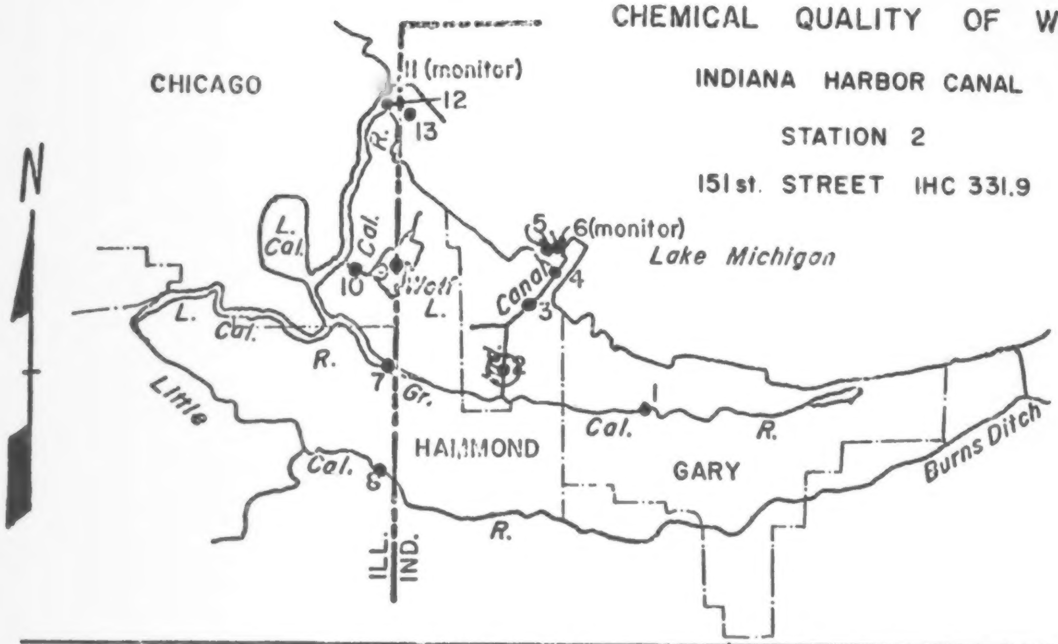
TABLE I - 2

CHEMICAL QUALITY OF WATER

INDIANA HARBOR CANAL

STATION 2

151st. STREET IHC 331.9



Parameter		June 1965-Nov. 1965 Max	Min	Mean	Median	Jan. 1966-June 1966 Max	Min	Mean	Median
pH		7.3	6.7	7.0	7.1	7.9	6.5	7.0	7.0
Conductivity	umho/cm	--	--	--	--	530	430	473	480
DO	mg/1	5.0	2.1	3.6	3.8	8.1	0.20	5.07	5.60
BOD	"	12	4.4	7.9	7.3	22	4.9	8.9	7.6
COD	"	65	7.7	29	14	60	18	29	28
Sulphates	"	71	50	56	56	138	74	88	87
Chlorides	"	--	--	--	--	70	29	36	32
MBAS	"	--	--	--	--	0.61	0.16	0.29	0.29
NH_3-N	"	4.0	0.77	1.8	2.3	4.7	2.4	3.4	3.3
NO_2-NO_3 N	"	2.2	0.23	1.2	1.1	1.5	0.21	0.80	0.80
Org-N	"	4.3	0.30	1.5	1.3	1.3	0.00	0.6	0.7
Total PO_4	"	4.6	0.52	1.3	0.81	2.0	0.32	0.82	0.75
Sol. PO_4	"	0.64	0.19	0.49	0.48	1.32	0.19	0.58	0.50
Iron	"	5.7	0.78	2.4	1.6	17	1.8	5.5	4.4
Phenol	ug/1	41	9	19	15	228	23	107	111
Cyanide	mg/1	0.17	0.00	0.03	0.00	0.44	0.00	0.19	0.16
Susp.Solids	"	59	16	30	27	110	23	61	59
Dis.Solids	"	640	240	315	280	375	250	295	295
Temperature	°C	27	13	20.6	20	26	5	15	15

1965 data based on 9 samples.
1966 data based on 26 samples except for: NH_3, NO_4 and Org-N(25); conductivity (19); ABS(19) and chlorides(19).

Indiana Harbor Canal at Dickey Road (Station 3)

This station is located two and a half miles downstream from 151st Street (Station 2) and is the last highway bridge across the canal before it discharges into Indiana Harbor.

The trends evident at the two upstream stations are repeated at this station. The bacteriological counts are lows in 1966, the dissolved oxygen highs, and the industrial pollution greater.

The total coliform counts varied from 13,000 to 440,000, with an average of 116,000 and a median of 96,000. As indicated on Figure I-2, these values are considerably lower than the June-November 1965 counts, but they are still high and indicate severe pollution.

The fecal coliform count varied from 2,600 to 370,000, with an average of 71,000 and a median of 39,000. The fecal streptococci varied from 340 to 52,000, with an average of 16,740, and a median of 5,300. Both of these parameters are high, but are considerably lower than in 1965, as shown in Figures I-4 and I-6.

This improvement is due to the separation programs started by several industries to separate sanitary wastes and send them to municipal sewage treatment plants. The counts at Dickey Road are only slightly higher than those at 151st Street. This indicates that, although the sewage pollution contributed by the industries between the two stations has been reduced, it is still enough to make up for the normal die-off between the two stations. The average dissolved oxygen rose from 0.5 mg/l to 3.10 mg/l, although two zero readings were found during June 1966 and all the readings during June 1966 were extremely low. It is evident that there has been some decrease in sewage pollution.

The average sulphates concentration increased from 65 mg/l in 1965 to 80 mg/l in 1966; the average iron concentration increased from 2.40 mg/l to 3.16 mg/l; the average phenol concentration increased from 20 ug/l to 102 ug/l; and the average suspended solids content increased from 14 mg/l to 25 mg/l. It is noted that, as at the other stations, the rise in phenols is magnified by the cold weather, but this effect is minimized by the cooling water discharged to the stream. The minimum water temperature at this station during 1966 was 9°C. The average cyanide appears to have increased from 0.00 mg/l to 0.13 mg/l, but the 1965 data is too low due to interference with the chemical analysis.

The concentration of sulphates, iron, phenols, cyanide and suspended solids decrease toward downstream. It must be pointed out, however, that the total flow increases considerably as you go down stream. The estimated average flow at Station 1 is 650 cfs; at Station 2 it is 955 cfs, and at Dickey Road it is approximately 1,000 cfs. This additional dilution water, the natural deterioration of phenols and cyanides and the settling to the bottom of suspended solids and iron, are responsible for this apparent improvement in quality of downstream waters.

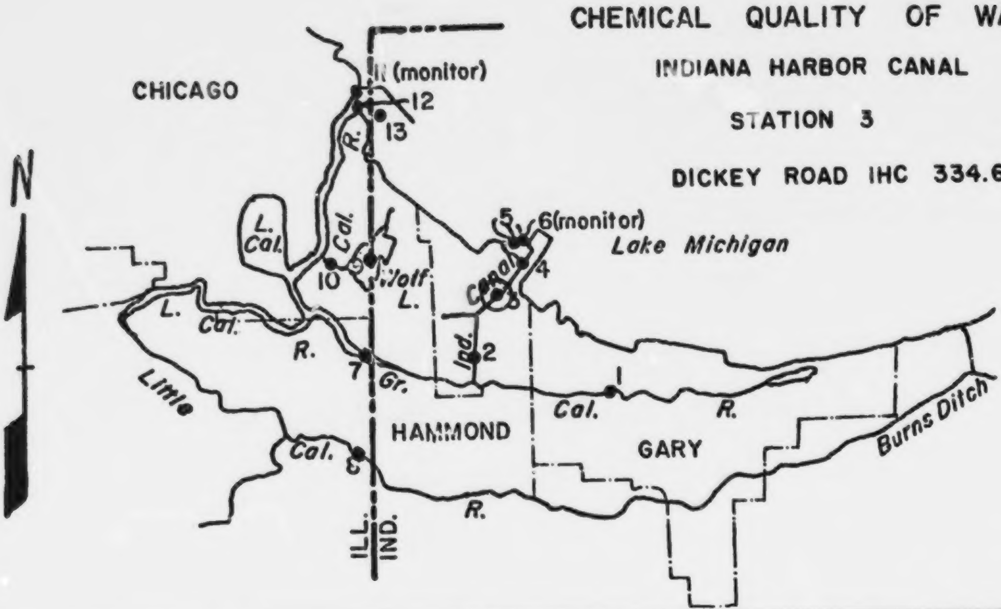
TABLE I - 3

CHEMICAL QUALITY OF WATER

INDIANA HARBOR CANAL

STATION 3

DICKEY ROAD IHC 334.6



Parameter		June 1965-Nov. 1965 Max	Min	Mean	Median	Jan. 1966-June 1966 Max	Min	Mean	Median
pH		7.3	6.3	7.0	7.0	8.0	6.4	6.9	7.0
Conductivity	umho/cm	--	--	--	--	615	400	501	505
DO	mg/1	2.9	0.0	0.3	0.0	6.70	0.00	3.10	4.10
BOD	"	11	3.5	6.3	5.5	9.0	2.2	5.1	5.3
COD	"	48	0.0	23	20	33	12	22	22
Sulphates	"	77	46	65	66	122	59	80	78
Chlorides	"	--	--	--	--	44	22	29	29
MBAS	"	--	--	--	--	0.35	0.17	0.24	0.24
NH_3-N	"	3.1	1.1	2.3	2.4	6.7	2.6	3.7	3.6
NO_2-NO_3 N	"	3.5	0.31	1.1	1.1	2.8	0.15	0.84	0.75
Org-N	"	3.8	0.08	1.9	2.1	2.4	0.3	0.7	0.6
Total PO_4	"	0.91	0.24	0.57	0.53	0.73	0.26	0.47	0.46
Sol. PO_4	"	0.57	0.01	0.26	0.29	0.54	0.11	0.32	0.29
Iron	"	3.8	0.88	2.4	2.2	9.0	0.99	3.16	2.3
Phenol	ug/1	42	1	20	20	483	16	102	61
Cyanide	mg/1	0.00	0.00	0.00	0.00	0.56	0.00	0.13	0.13
Susp. Solids	"	23	6	14	12	84	6	25	19
Dis. Solids	"	340	240	260	300	385	220	314	310
Temperature	°C	29	13	23.0	25	27	9	15	14

1965 data based on 19 samples except for: cyanide (18) and susp. solids(10). 1966 data based on 26 samples except for chlorides(19); ABS(19) and conductivity(19).

R. J. Bowden

Indiana Harbor (Stations 4, 5 and 6)

Indiana Harbor was sampled at three points during January-June 1966. Station 4 is located at the mouth of the Indiana Harbor Canal, upstream of the Inland Steel and Youngstown Sheet and Tube turning basins. Station 5 is located immediately downstream of the turning basins and downstream from all industrial outfalls to the harbor. The average dry weather flow to Lake Michigan past this station is 2,700 cfs, but under certain wind and lake level conditions lake water is backed up into the harbor for short periods of time. Station 6 is located at the east breakwall inner light which is about 150 feet from Station 5 and contains a water quality monitoring station. Station 6 was established during January 1966 to correlate the monitoring program with the sampling program.

Stations 4 and 5 are boat stations and cannot be sampled in rough weather. During 1966 they were not sampled until March 31, 1966; therefore the data at these stations is affected less by the colder months.

The trends established at the upstream stations are evident at these stations. At Station 4 the total coliform count varied from 5,100 to 77,000, with an average of 28,000 and a median at 15,000. These values are approximately one-tenth of their level in June-November 1965. This indicates that progress has been made by the industries in separating the industrial and domestic wastes. The remaining high levels of these counts indicate that a problem still exists. Figures I-4 and I-6 show that the fecal coliform and fecal streptococci are at the same level as in 1965. The fact that total coliforms decreased while fecal coliforms and fecal streptococci remained the same, indicates that the remaining pollution is fresh and may be caused by passing or moored vessels.

At Station 5 the total coliform count varied from 13,000 to 140,000 with an average of 66,000 and a median of 66,000. As indicated in Figure I-2, these values are at the same level as they were in June-November 1965. The fecal coliform counts varied from 19,000 to 1,600 with an average of 8,900 and a median of 8,700. Figure I-6 indicates that these values are considerably higher than in 1965. The fecal streptococci counts varied from 1,100 to 32, with an average of 279 and a median of 220. Figure I-4 indicates that these values are in the same range as in 1965, but that the average is somewhat lower.

At Station 6, near the monitor, the total coliform count varied from 330,000 to 1,000, with an average of 34,000 and a median of 15,000. The fecal coliform varied from

5,800 to less than 10, with an average of 1,929 and a mean of 1,700. The fecal streptococci varied from 1,600 to 15, with an average of 355 and a median of 190. As shown in Figures I-2 and I-6, the average median and minimum counts for total and fecal coliform are significantly lower than the counts at Station 5, which is only 150 feet away. Station 6 was sampled during the entire period from January to June, whereas Station 5 was only sampled from April to June because it is a boat station. Thus a comparison of the data from these two stations gives some indication of the effect of the colder months on the bacteriological data. It is interesting to note that the fecal streptococci counts were not affected nearly as much by the colder weather. This phenomenon has been noted throughout all of the data collected by the Project.

The counts in the harbor are all lower than those at Dickey Road (Station 3). This is partially due to the fact that there is a much greater dilution factor in the harbor. The estimated flow at Station 5 is 2,700 cfs versus 1,000 cfs at Dickey Road. There is still a considerable amount of bacteriological pollution being discharged to Lake Michigan in close proximity to several water supply intakes and bathing beaches. The improvement in the sanitary condition of the canal is not as dramatic at Stations 4 and

5 as it is at the upstream stations. At Station 4 the average dissolved oxygen increased slightly from 3.4 mg/1 in 1965 to 3.74 mg/1 in 1966, and total coliform is the only bacterial count that showed a significant decrease. At Station 5 the dissolved oxygen rose slightly, but the bacterial counts were higher in 1966 than in 1965. The sanitary conditions at these stations are undoubtedly affected by vessel pollution.

At Station 4 the average sulphate concentration rose from 51 mg/1 in 1965 to 65 mg/1 in 1966, and the phenols rose from an average of 12 ug/1 in 1965 to 18 μg/1 in 1966. Cyanide appears to have risen from an average of 0.00 mg/1 to 0.07 mg/1, but interference with the analysis affected the 1965 data. The average concentration of iron at Station 4 remained the same, but is considerably higher at Station 4 than at Station 3, which indicates that a considerable amount of iron is being discharged to the canal between these two stations.

Station 6, which was not sampled in 1965, is located about 300 feet from Station 5. A comparison of Tables I-5 and I-6 indicates that there is no significant difference in the data between these two stations except that the dissolved oxygen is higher at Station 6. This is probably due to the turbulence around the structure and the large growths of algae on the structure. Station 6 was sampled during January, February and March, while Station 5 was not. This, of course, increased the average DO, but the average DO at Station 6 from March 31, 1966, through June 29, 1966, was 5.89 mg/1, which is still higher than the 4.63 mg/1 found at Station 5.

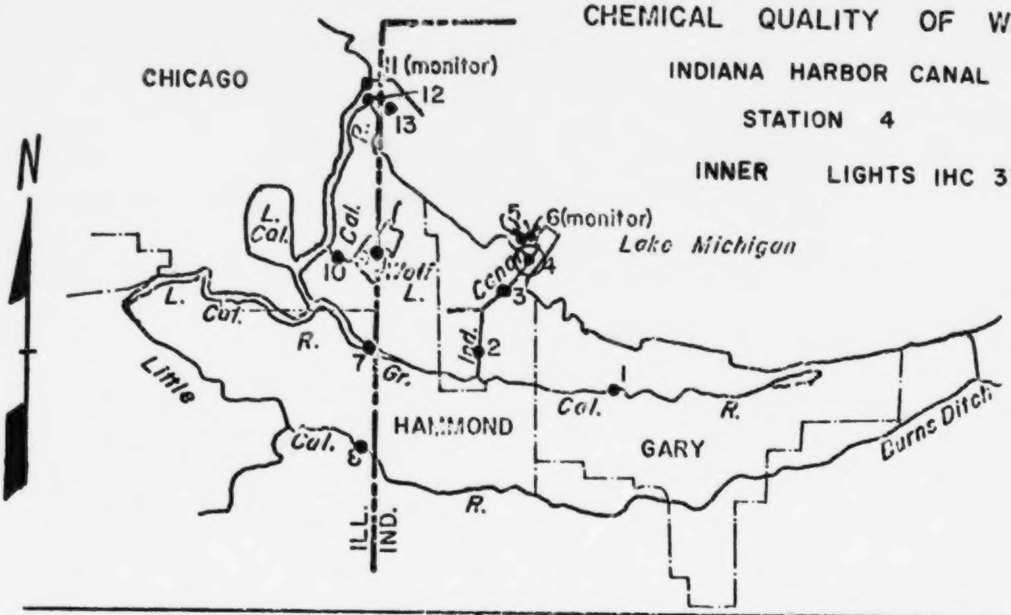
TABLE I - 4

CHEMICAL QUALITY OF WATER

INDIANA HARBOR CANAL

STATION 4

INNER LIGHTS IHC 335.7



Parameter		June 1965-Nov. 1965 Max	Min	Mean	Median	Jan. 1966-June 1966 Max	Min	Mean	Median
pH		7.3	6.9	7.1	7.1	8.0	6.8	7.1	7.0
Conductivity	umho/cm	--	--	--	--	460	385	419	420
DO	mg/l	5.9	2.4	3.4	2.4	5.2	2.05	3.74	3.60
BOD	"	9.1	2.8	4.8	3.7	5.0	2.4	3.8	4.1
COD	"	67	0.0	20	9.3	18	11	13	15
Sulphates	"	62	34	51	54	84	23	65	70
Chlorides	"	--	--	--	--	30	21	25	25
MBAS	"	--	--	--	--	0.25	0.07	0.17	0.17
NH_3-N	"	1.4	0.75	1.1	1.1	5.6	2.2	3.2	3.0
NO_2-NO_3 N	"	0.74	0.29	0.42	--	0.55	0.11	0.31	0.30
Org-N	"	1.7	0.30	1.1	1.3	0.9	0.0	0.4	0.4
Total PO_4	"	0.23	0.08	0.16	0.15	0.27	0.09	0.18	0.20
Sol. PO_4	"	0.10	0.03	0.06	0.06	0.19	0.06	0.14	0.15
Iron	"	5.0	2.1	3.1	2.6	4.9	1.5	3.0	3.0
Phenol	ug/l	21	6	12	9	26	11	18	18
Cyanide	mg/l	0.01	0.00	0.00	0.00	0.25	0.00	0.07	0.07
Susp. Solids	"	105	10	36	13	81	11	21	16
Dis. Solids	"	255	215	240	250	305	230	263	265
Temperature	°C	25	17	21.8	22	24	12	18	19

1965 data based on 6 samples except for: susp. solids(4) and dis.solids(3).
1966 data based on 12 samples except for NH_3, NO_3, and Org-N (11).

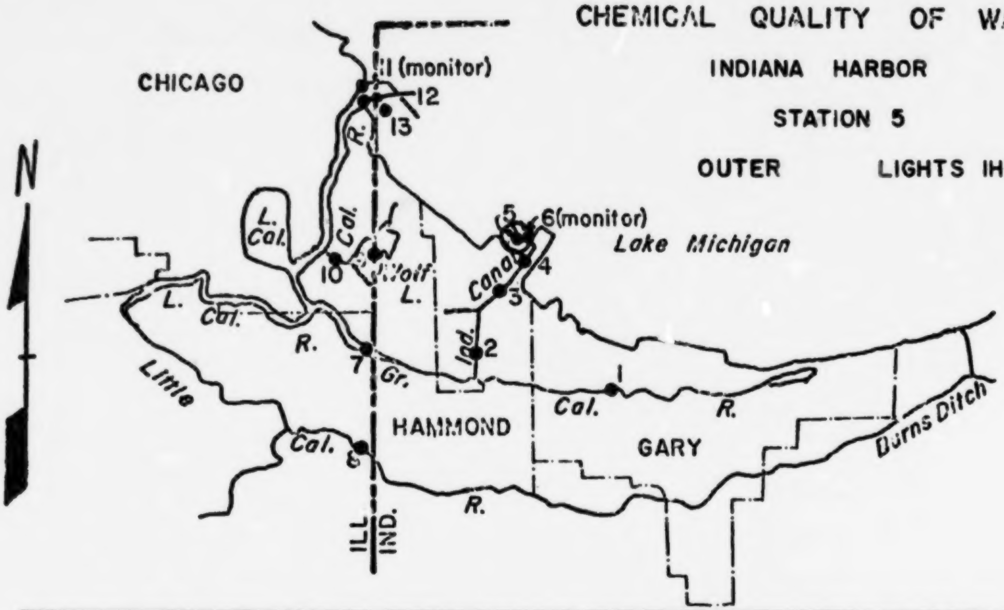
TABLE I - 5

CHEMICAL QUALITY OF WATER

INDIANA HARBOR

STATION 5

OUTER LIGHTS IHC 336.2



Parameter		June 1965-Nov. 1965				Jan. 1966-June 1966			
		Max	Min	Mean	Median	Max	Min	Mean	Median
pH		7.3	6.9	7.1	7.1	7.9	6.8	7.0	7.0
Conductivity	umho/cm	--	--	--	--	420	350	384	385
DO	mg/1	6.1	1.9	4.2	4.2	6.65	3.05	4.63	4.80
BOD	"	13	2.3	4.5	3.0	5.5	2.0	3.3	3.5
COD	"	67	8.4	20	8.6	27	8	13.3	13
Sulphates	"	54	32	45	50	81	45	62	62
Chlorides	"	--	--	--	--	26	16	22	23
MBAS	"	--	--	--	--	0.21	0.10	0.14	0.14
NH_3-N	"	1.4	0.26	0.89	0.73	4.4	1.5	2.4	2.4
NO_2+NO_3 N	"	0.59	0.10	0.42	0.44	0.45	0.12	0.29	0.32
Org.-N	"	1.4	0.10	0.73	0.71	0.8	0.00	0.2	0.2
Total PO_4	"	0.21	0.06	0.14	0.15	0.19	0.08	0.12	0.14
Sol. PO_4	"	0.12	0.03	0.07	0.07	0.11	0.00	0.07	0.08
Iron	"	3.0	1.3	1.9	1.7	5.6	1.3	3.0	3.1
Phenol	ug/1	7	0	4	3	19	5.4	10.4	10.0
Cyanide	mg/1	0.01	0.00	0.00	0.00	0.19	0.01	0.05	0.02
Susp. Solids	"	13	3.0	5.0	5.0	3.7	9.0	14.8	13
Dis. Solids	"	255	230	175	235	280	205	240	235
Turbidity	units	--	--	--	--	11.2	1.8	6.3	6.2
Temperature	°C	26	17	22.2	21	23	12	17	17

1965 data based on 6 samples except for: susp. solids(4) and dis. solids (3).
1966 data based on 12 samples.

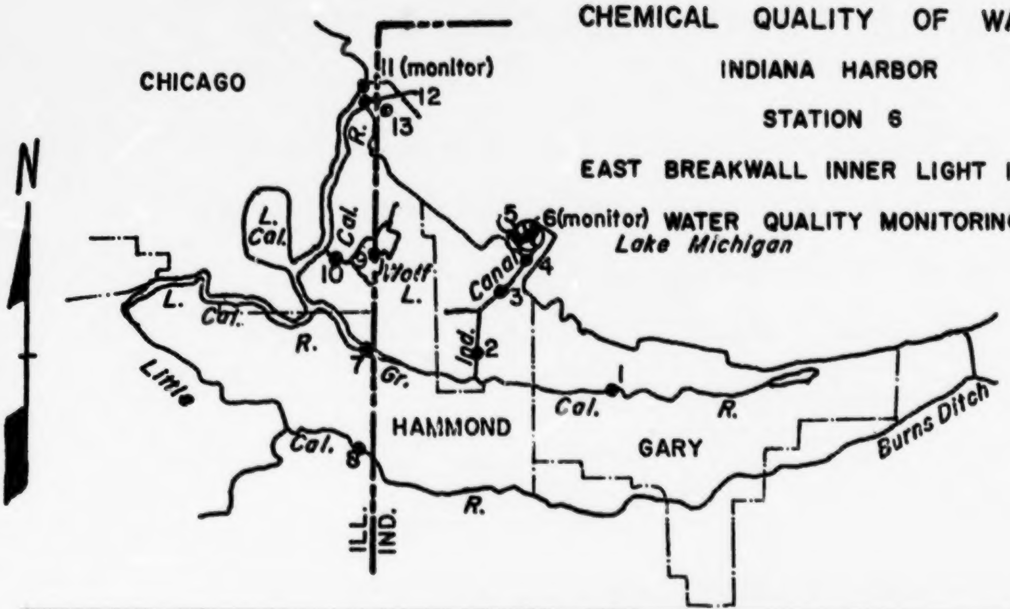
TABLE I - 6

CHEMICAL QUALITY OF WATER

INDIANA HARBOR

STATION 6

EAST BREAKWALL INNER LIGHT IHC 336.25



Parameter		June 1965-Nov. 1965 Max	Min	Mean	Median	Jan. 1966-June 1966 Max	Min	Mean	Median
pH						8.0	6.6	7.07	7.0
Conductivity	umho/cm					460	320	372	385
DO	mg/l					8.0	2.80	6.50	7.1
BOD	"					5.6	1.7	3.4	3.6
COD	"					37	4.0	12.0	11.0
Sulphates	"					77	34	59	66
Chlorides	"					32	10	21	22
MBAS	"					.35	.08	.15	.15
NH_3-N	"					2.8	0.19	1.9	1.9
NO_2-NO_3 N	"					0.70	0.12	0.42	0.40
Org.-N	"					2.1	0.2	0.6	0.5
Total PO_4	"					0.34	0.08	0.14	0.13
Sol. PO_4	"					0.30	0.03	0.09	0.08
Iron	"					8.1	1.3	3.1	3.0
Phenol	ug/l					45	1.4	15.6	14
Cyanide	mg/l					0.20	0.00	0.08	0.07
Susp. Solids	"					46	8	17	15
Dis. Solids	"					265	200	239	240
Temperature	°C					19	6	12	12

Station not sampled during 1965.
1966 data based on 26 samples except for: chlorides(19); ABS(19).

R. J. Bowden

Grand Calumet River at Indiana Harbor Belt R. R. Bridge (Station 7)

This station is located in Illinois just across the Illinois-Indiana State line and is designed to measure the amount of pollution crossing the State line. This station is one of the control points established by the Calumet Area Technical Committee.

The bulk of the dry weather flow in this stream is made up of effluent from the Hammond Sewage Treatment Plant and industrial effluent from one steel company and several smaller companies.

The stream at this point is grossly polluted. The twenty-six samples collected by the Surveillance Project during the period of this report had a maximum total coliform count of 5,300,000, a minimum of 28,000, a mean of 970,000, and a median of 590,000. As can be seen in Figure I-1, these values compare closely to the values for June-November 1965. Figures I-3 and I-5 indicate that fecal coliform and fecal streptococci are considerably higher in 1966. The maximum fecal streptococci rose to 530,000, with a minimum of 500, a mean of 35,000, and a median of 12,000. The fecal coliform ranged from 1,000 to 620,000, with a mean of 106,000 and a median of 63,000. The mean and median for both fecal streptococci and fecal coliform rose considerably from their June-November 1965 levels. This increase is significant because the colder months of January, February and March would normally cause a decrease.

The chemical data presented in Table No. I-7 indicates an average chloride content of 87 mg/1, an average sulphate content of 187 mg/1, an average ammonia content of 14.7 mg/1, an average total phosphate content of 7.67 mg/1, and an average dissolved solids content of 688 mg/1. All of these parameters are considerably above the recommended criteria and are normally found in raw or partially treated sewage.

The industries above this station probably contribute a considerable quantity of the sulphates found at the station, but the other parameters such as iron, phenol and cyanide, which are normally associated with the steel industry, are not high. The primary source of the pollution at this point appears to be the sewage treatment plant at Hammond.

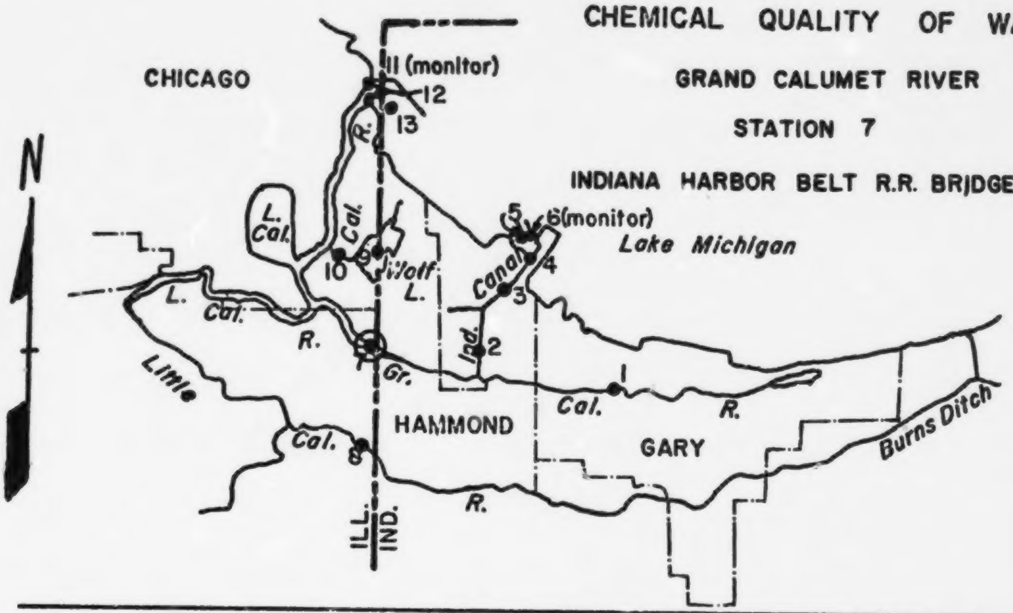
TABLE I - 7

CHEMICAL QUALITY OF WATER

GRAND CALUMET RIVER

STATION 7

INDIANA HARBOR BELT R.R. BRIDGE GC 328.5



Parameter		June 1965-Nov. 1965 Max	Min	Mean	Median	Jan. 1966-June 1966 Max	Min	Mean	Median
pH		7.2	6.5	7.0	7.0	8.2	6.8	7.24	7.2
Conductivity	umho/cm	--	--	--	--	1150	410	922	1020
DO	mg/l	5.4	0.0	2.7	2.7	6.4	0.00	4.00	4.2
BOD	"	20	4.6	11	7.3	104	3.2	26.4	21
COD	"	108	16	47	26	224	25	67	56
Sulphates	"	282	52	179	179	280	76	187	192
Chlorides	"	--	--	--	--	180	22	87	85
MBAS	"	--	--	--	--	1.8	.15	.70	.63
NH_3-N	"	7.8	1.2	2.9	2.4	12	0.55	4.72	3.9
NO_2NO_3 N	"	13	1.2	5.3	4.6	15	1.1	6.3	6.4
Org-N	"	3.7	0.05	0.90	1.8	6.6	0.6	2.4	1.9
Total PO_4	"	12	5.4	7.7	6.9	16.0	0.90	7.67	7.0
Sol. PO_4	"	9.2	1.3	5.2	5.5	10.1	0.3	2.9	2.0
Iron	"	17	0.27	2.8	0.82	7.9	0.6	2.13	1.3
Phenol	ug/l	46	4	18	16	90	3.1	24.4	19
Cyanide	mg/l	0.12	0.00	0.02	0.00	0.05	0.00	.0096	.01
Susp. Solids	"	155	7	38	20	110	5	38	28
Dis. Solids	"	705	58	480	540	770	270	668	700
Turbidity	units	--	--	--	--	19.5	1.8	6.2	5.1
Temperature	°C	21	6	15.9	17	23	3	11	9

1965 data based on 9 samples.
1966 data based on 26 samples except for: turbidity(19); chlorides(19); ABS(19).

Little Calumet River at Wentworth Avenue (Station 8)

The Wentworth Avenue station was established to monitor the wastes in the Little Calumet River flowing from Indiana to Illinois. The station is located approximately one-half mile downstream from the State line and is one of the control points established by the Calumet Area Technical Committee. The closest gauging station for flow data is a United States Geological Survey station located about one mile upstream at Hohman Avenue. There are no significant sources of flow between the two stations.

As reported in the report covering the period June-November 1965 considerable progress has been made on this stream since the Great Lakes Illinois River Basin Project sampled it in 1963. The twenty samples taken by the GLIRB Project during August and September of 1963 indicated severe pollution from domestic sewage, with an average total coliform count of 1,600,000 and a minimum of 130,000. The average value for fecal streptococci during this period was 80,000, with a minimum of 19,000. In 1965 the average total coliform count was 800,000, with a maximum of 3,500,000 and a minimum of 20,000. The average fecal streptococci had been reduced to 6,300, with a maximum of 150,000 and a minimum of 13,000.

The data for the first six months of 1966 is somewhat lower. As indicated in Figure I-1, the total coliform ranged from 13,000 to 2,200,000, with an average of 330,000 and a median of 110,000. This reduction is probably due to the lower counts during the colder months of January, February and March, and it does not appear that the quality of the water has changed substantially since 1965.

Table I-8 indicates the average dissolved oxygen in January-June 1966 was 6.4 mg/l, compared with 1.8 mg/l for June-November 1965. The DO for June 1966, however, was below 2.0 mg/l, and is comparable to the DO for June 1965. Therefore, this apparent improvement in DO is probably the result of the cold weather samples. Table I-8 further shows that BOD and COD decreased somewhat, but sulphates increased. Ammonia and organic nitrogen both decreased slightly, while nitrates increased. Total phosphates and soluble phosphates decreased slightly, while phenols increased. The increase in phenols is also due to the colder months, since it is not degraded as rapidly at lower temperatures. The suspended solids decreased while the dissolved solids increased.

The stream at this point is not as grossly polluted as it was in 1963, but it still does not meet the criteria recommended by the technical committee. The improvement is due to the diversion of sewage from Griffith and

Highland to the Hammond Sewage Treatment Plant. The remaining problems are due to some industrial pollution, combined sewer overflows and storm sewer outfalls. The combined sewer overflows are probably the cause of the high bacteria counts still found at this station on several occasions.

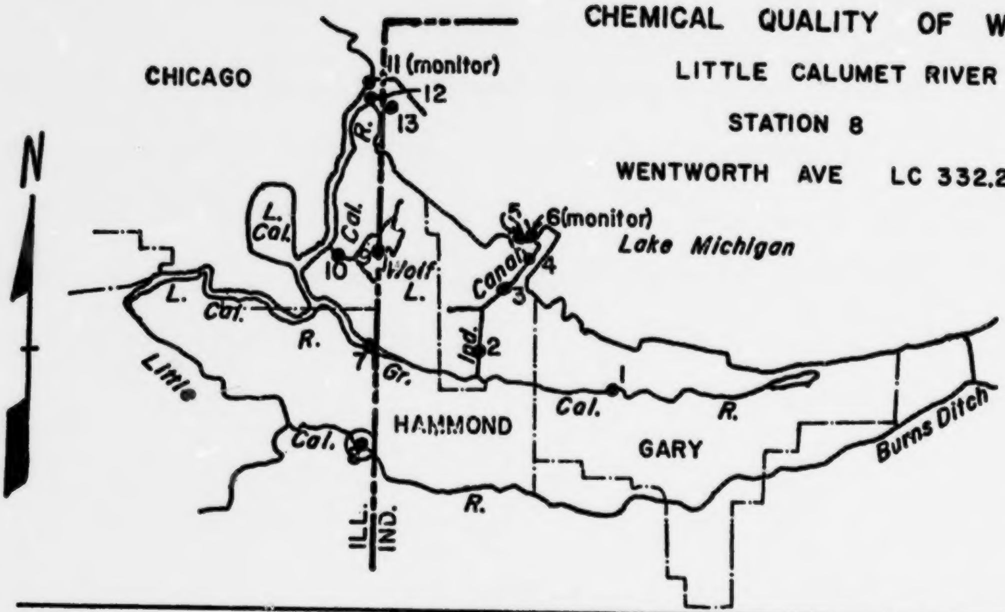
TABLE I - 8

CHEMICAL QUALITY OF WATER

LITTLE CALUMET RIVER

STATION 8

WENTWORTH AVE LC 332.2



Parameter		June 1965-Nov. 1965 Max	Min	Mean	Median	Jan. 1966-June 1966 Max	Min	Mean	Median
pH		8.8	7.1	7.4	7.3	8.0	7.0	7.5	7.5
Conductivity	umho/cm	--	--	--	--	1220	425	808	765
DO	mg/1	5.0	0.0	1.8	1.5	11.0	0.2	6.4	7.3
BOD	"	35	3.9	13	10	16	3.9	8.2	7.8
COD	"	79	5.9	45	51	89	20	45	39
Sulphates	"	310	57	172	170	300	101	187	180
Chlorides	"	--	--	--	--	55	17	41	44
MBAS	"	--	--	--	--	.76	.15	.28	.25
NH_3-N	"	3.7	0.42	2.1	2.1	3.1	.35	1.4	1.4
NO_2-NO_3 N	"	4.4	0.04	1.3	0.72	4.3	.12	1.7	1.8
Org-N	"	8.6	0.13	3.2	2.8	2.95	0.8	1.7	1.4
Total PO_4	"	14	1.5	5.3	4.5	6.9	.22	3.5	3.0
Sol. PO_4	"	9.7	0.51	3.4	3.6	3.1	0.0	1.4	1.1
Iron	"	3.8	0.45	1.5	1.2	3.1	.44	1.0	.91
Phenol	ug/1	38	0	8	6	39	.24	12.4	9.3
Cyanide	mg/1	.12	0.00	0.01	0.00	.02	.00	.005	.00
Susp. Solids	"	705	17	175	41	980	13	89	32
Dis. Solids	"	640	110	470	505	860	255	595	570
Turbidity	units	--	--	--	--	103	1.2	15.6	9.0
Temperature	°C	24	4	16.2	18	23	0	8	7

1965 data based on 19 samples except for cyanide(17); susp.solids(10); dissolved solids(10).
1966 data based on 25 samples except for turbidity(19); conductivity(18) chlorides(19), ABS(19).

Wolf Lake and Outlet (Stations 9 and 10)

Wolf Lake, which is located on the Indiana-Illinois State line, has been sampled at two points. Station 9 is directly on the State line, which runs along a causeway that bisects the lake. This station monitors the quality of the water crossing the State line, and has been established as a control point by the Calumet Area Technical Committee. Station 10 is located on the Wolf Lake outlet at Carondolet Avenue about 3,000 feet downstream from Wolf Lake and monitors the quality of the water leaving the lake.

The quality of the water at Station 9 is good and meets the recommended criteria in most respects. During the first six months of 1966 the total coliform count ranged from 4 to 1,300, with an average of 116 and a median of 50. The fecal coliform counts ranged from less than 1 to 660, with an average of 38 and a median of 6. The fecal streptococci varied from less than 1 to 50, with an average of 12 and a median of less than 10. Figures I-2 and I-4 show that the total coliform and fecal streptococci are lower than in June-November 1965, while the fecal coliform remained the same. The 1966 data is biased by the cold months, the temperature being zero degrees centigrade for over a month. The data indicates no significant change in quality since

1965.

The criteria for ammonia are not met but the maximum value was 0.56 mg/1, which does not indicate a serious problem. The ammonia content appears to have increased slightly since 1965, but the 1965 data is based on only two samples and is not affected by the colder temperatures which inhibit the microbiological action that breaks down ammonia. The nitrates and organic nitrogen which are products of that microbiological action decreased slightly in the 1966 data.

The only pollution problem which is evident at this station is MBAS. MBAS concentrations vary from a maximum of 0.19 mg/1 to 0.10 mg/1, with an average of 0.12 mg/1 and a median of 0.11 mg/1. These values are considerably above the recommended criteria and foam has been noted on the lake on several occasions. On two occasions during August of 1966 our beach sampler reported that the lake was covered with foam and all recreational uses were suspended.

The detergents originate at the Lever Brothers Company. In general, these wastes do not inhibit the use of the lake, which is widely used for swimming, boating, fishing and water skiing, but on occasion an acute problem is caused by spills or accidental discharges which prevent all use of the lake, and could possibly affect the fish population of the lake if the foam persisted for an extended period.

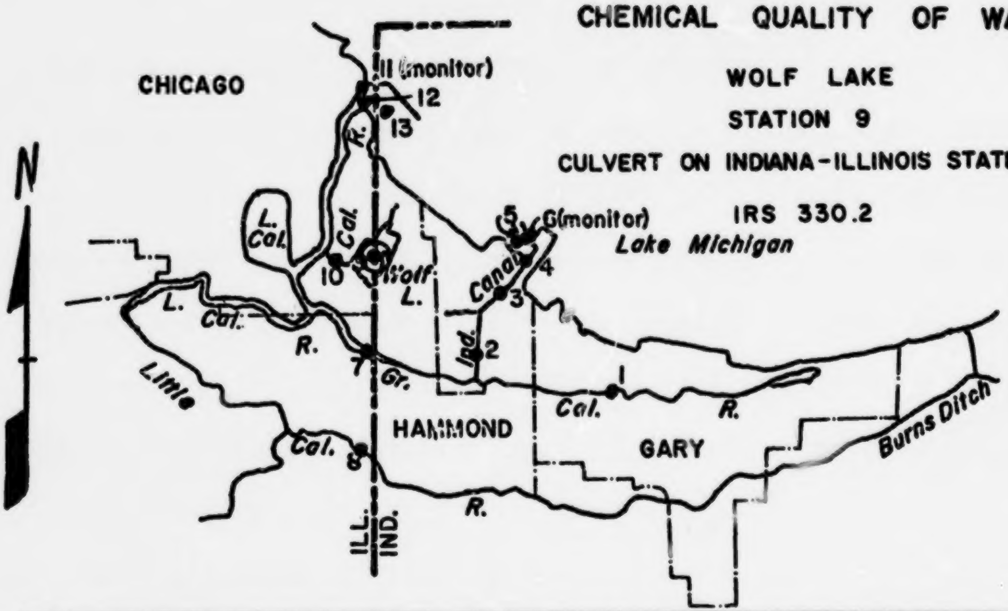
On January 26, 1966, 0.35 mg/1 of cyanide was found at Station 9. The source of this cyanide is not known. It is possible that this is an erroneous finding since no cyanide was detected in the other 25 samples taken at this point, and none was found in the outlet at Station 10 on that date. Cyanides were detected at Station 10 on four occasions but never more than 0.02 mg/1. It is possible that occasional discharges are coming from one of the industries on the lake.

The water quality at Station 10 is generally the same as at Station 9. The sulphates and phenols are somewhat higher and the solids content is slightly increased, but all of the other parameters are almost equal. The solids content would normally be higher in a small stream running through an area of dense vegetation than in an open lake, but the reasons for the increased phenols and sulphates are not clear.

TABLE I-9

CHEMICAL QUALITY OF WATER

WOLF LAKE
STATION 9
CULVERT ON INDIANA-ILLINOIS STATE LINE
IRS 330.2



Parameter		June 1965-Nov. 1965 Max	Min	Mean	Median	Jan. 1966-June 1966 Max	Min	Mean	Median
pH		8.2	8.1			9.8	7.5	8.1	8.0
Conductivity-	umho/cm	--	--			460	350	414	400
DO	mg/1	11.0	10.0			15	7.70	11.04	11.2
BOD	"	5.5	3.7			7.8	1.9	3.9	3.7
COD	"	23	22			26	10	18	18
Sulphates	"	60	46			69	45	55	55
Chlorides	"	--	--			38	27	31	30
MBAS	"	--	--			.19	.10	.12	.11
NH_3-N	"	0.26	0.07			.56	.02	.28	.30
NO_2-NO_3 N	"	0.40	0.38			1.2	.03	.38	.30
Org-N	"	0.94	0.82			1.19	.51	.76	.71
Total PO_4	"	0.15	0.11			.34	.04	.11	.08
Sol. PO_4	"	0.00	0.00			.07	.00	.02	.02
Iron	"	0.38	0.28			.56	.04	.24	.22
Phenol	ug/1	20	1			19	.14	3.05	2
Cyanide	mg/1	0.00	0.00			.35	.00	.01	.00
Susp. Solids	"	51	2.4			48	4	13	9
Dis. Solids	"	265	255			320	180	268	265
Turbidity	units	--	--			4.2	0.5	2.3	2.1
Temperature	°C	--	--			24	0	8	5

1965 data based on 2 samples.
1966 data based on 26 samples except for sol.phosphate(25); conductivity(19) turbidity(19); ABS(19); chlorides(19).

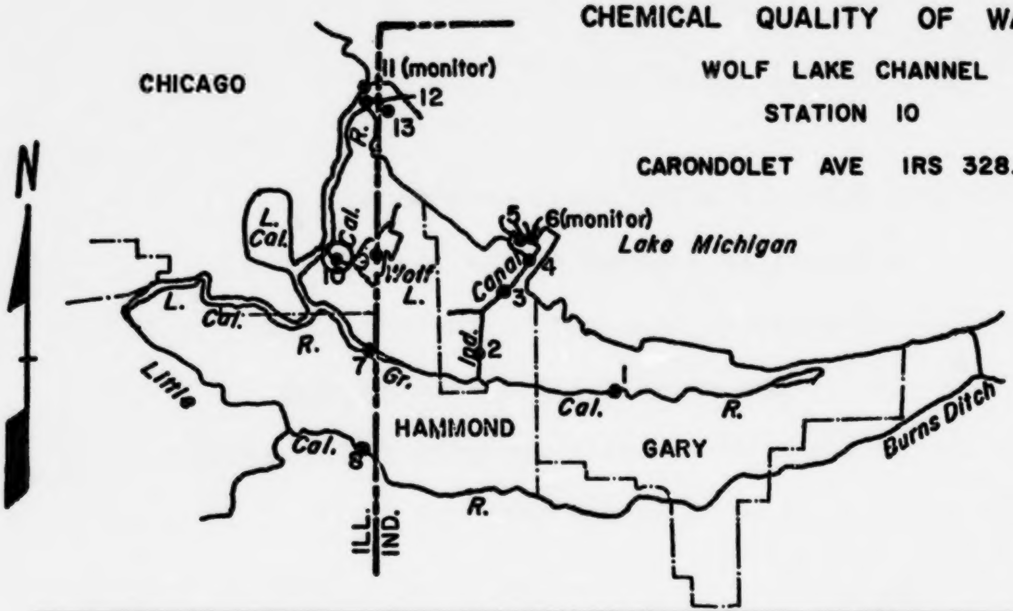
TABLE I - 10

CHEMICAL QUALITY OF WATER

WOLF LAKE CHANNEL

STATION 10

CARONDOLET AVE IRS 328.9



Parameter		June 1965-Nov. 1965 Max	Min	Mean	Median	Jan. 1966-June 1966 Max	Min	Mean	Median
pH		8.4	8.2			8.8	7.9	8.47	8.5
Conductivity	umho/cm	--	--			545	370	463	460
DO	mg/l	9.9	8.0			14.0	5.9	10.6	11.4
BOD	"	2.4	1.9			5.0	1.9	3.1	3.3
COD	"	20	12			26	12	18	18
Sulphates	"	55	45			92	69	77	77
Chlorides	"	--	--			37	30	34	35
MBAS	"	--	--			.24	.09	.13	.12
NH_3-N	"	0.21	0.12			0.67	0.10	0.27	0.28
NO_2-NO_3 N	"	0.25	0.23			0.67	0.10	0.37	0.34
Org-N	"	0.83	0.61			1.11	0.35	0.70	0.62
Total PO_4	"	0.11	0.09			0.27	0.03	0.07	0.06
Sol. PO_4	"	0.06	0.01			0.24	0.00	0.03	0.02
Iron	"	0.37	0.22			0.77	0.05	0.23	0.23
Phenol	ug/l	7	0			15	1.4	6.8	8.0
Cyanide	mg/l	0.00	0.00			0.02	0.00	0.002	0.00
Susp. Solids	"	20	17			65	2	25	24
Dis. Solids	"	280	270			315	220	289	295
Temperature	°C	--	--			25	0	8	5

1965 data based on 2 samples.
1966 data based on 26 samples except for: conductivity(19); chlorides(19); ABS(19).

Calumet Harbor (Stations 11, 12 and 13)

There are three sampling stations located at Calumet Harbor. Station 11 is located at the mouth of the Grand Calumet River immediately adjacent to the north pierhead light. This station was established during January 1966 in order to correlate the sampling program with a water quality monitor which is located in the pierhead light structure.

Station 12 is located at the mouth of the Grand Calumet River at midstream. The purpose of this station is to monitor the quality of the water entering the river from the harbor.

Station 13 is located in mid-harbor, approximately 3,500 feet from the mouth of the river. This station monitors the quality of the water flowing in from Lake Michigan to the river. Stations 12 and 13 require a boat for sampling and, therefore, can be sampled only when the weather permits.

The operation of the O'Brien Lock tends to isolate the area by reversing the predominant flow of the river so that water flows from the lake to the river most of the time. For this reason the bulk of the pollution in the harbor and at the river mouth originates in the immediate area.

As shown in Figure I-1, the average and median total coliform counts for both the river mouth and the harbor were somewhat lower during the first six months of 1966 than during June-November 1965. The 1966 data is biased by the low values found during the cold months. The values for April, May and June of 1966 compare with the values of August and September of 1965 to indicate that there has been no significant change in the amount of microbiological pollution in the area.

One of the twenty-five samples taken at Station 11 showed considerably higher counts total and fecal coliforms than the remaining samples. These values (30,000 total coliforms and 18,000 fecal coliforms on April 29, 1966) were not included in the six-month average values and are shown separately on Figures I-1 and I-5. The high fecal coliform count indicates that the pollution was animal or human in origin. The field notes indicate that a boat passed while the sample was being taken. A sample taken 10 minutes earlier at Station 12, which is approximately 150 feet from Station 11, gave normal counts. These facts indicate that the pollution probably was a result of the passing vessel. This along with a similar incident discussed in the previous report, emphasizes the need for control of vessel pollution.

Since the primary flow at Calumet Harbor is from Lake Michigan to the river, the level of microbiological pollution is much lower than at Indiana Harbor. The pollution that does exist is local in origin and is probably due primarily to vessels using the harbor and the river. Tables I-11 and I-12 show that the chemical quality of the water at Station 11 and Station 12 is very similar. The dissolved oxygen and the suspended solids are somewhat higher near the monitor. This phenomenon, which also occurred at the Indiana Harbor Monitor, is explained by the turbulence caused by the structure. In addition, the phenol content is considerably higher near the monitor. This may be due to outfalls from the U. S. Steel Corporation which are located nearby and often cause the water to be discolored along the bank of the stream.

Since the primary flow is from the lake, the general quality of the water at each of these stations is good. Tables I-12 and I-13 show that there has been no significant change in the quality of the water since June-November 1965. Station 13 is in mid-harbor and represents the quality of the water coming from the lake. The increases in iron, phenol and suspended solids content between Stations 11 and 12 and Station 13 indicate the effect of the U. S. Steel outfalls on the harbor.

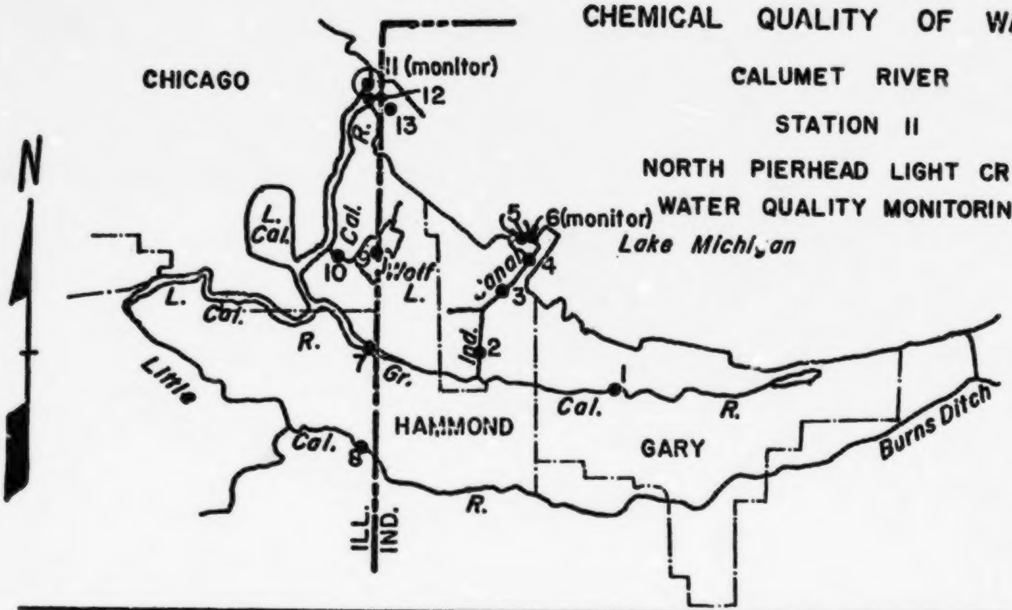
TABLE I - 11

CHEMICAL QUALITY OF WATER

CALUMET RIVER

STATION 11

NORTH PIERHEAD LIGHT CR 333.45
WATER QUALITY MONITORING STA.



Parameter		June 1965-Nov. 1965 Max	Min	Mean	Median	Jan. 1966-June 1966 Max	Min	Mean	Median
pH						8.3	7.4	7.8	7.8
Conductivity	umho/cm					330	203	298	300
DO	mg/1					14.1	4.2	10.1	10.4
BOD	"					4.9	0.9	2.5	2.2
COD	"					36	0.7	9.5	8.8
Sulphates	"					35	21	27	27
Chlorides	"					16	10	12	12
MBAS	"					.22	.03	.07	.05
NH_3-N	"					0.72	0.21	0.49	0.46
NO_2-NO_3-N	"					0.32	0.09	0.20	0.22
Org-N	"					0.70	0.05	0.34	0.31
Total PO_4	"					0.90	0.04	0.17	0.09
Sol. PO_4	"					0.78	0.00	0.11	0.04
Iron	"					8.6	0.09	2.1	1.1
Phenol	ug/1					15	0.6	2.9	2.7
Cyanide	mg/1					0.13	0.00	0.02	0.01
Susp. Solids	"					85	8	29	23
Dis. Solids	"					210	160	182	185
Temperature	°C					19	0	7	6

Station not sampled during 1965.
1966 data based on 25 samples except for: NH_3, NO_2, NO_3 and Org-N(24) Chlorides(19), ABS(19).

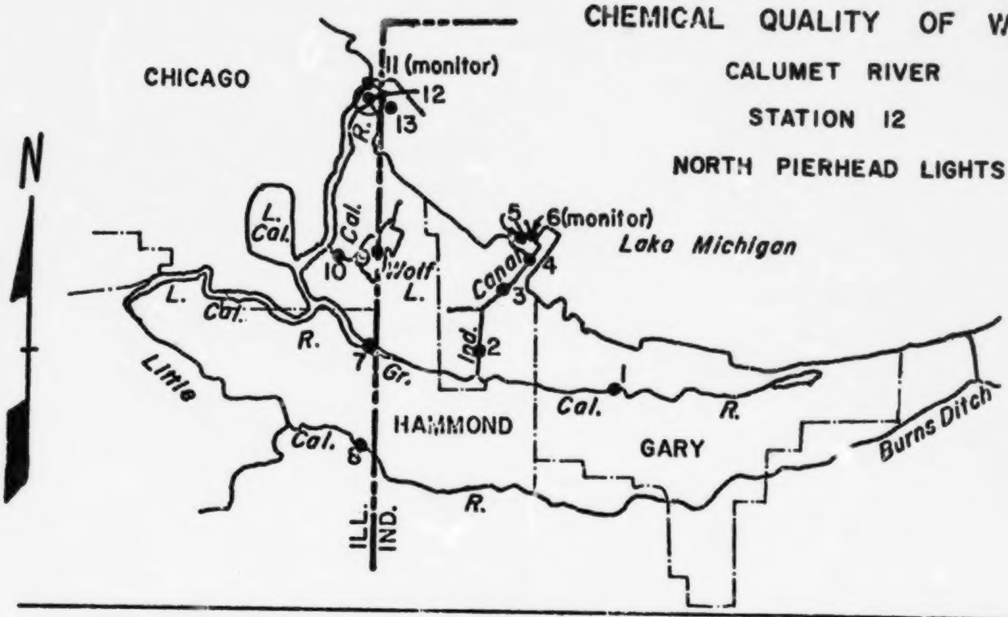
TABLE I - 12

CHEMICAL QUALITY OF WATER

CALUMET RIVER

STATION 12

NORTH PIERHEAD LIGHTS CR333.4



Parameter		June 1965-Nov. 1965				Jan. 1966-June 1966			
		Max	Min	Mean	Median	Max	Min	Mean	Median
pH		8.0	7.8	7.9	7.9	8.1	7.5	7.86	7.9
Conductivity	umho/cm	--	--	--	--	330	285	300	295
DO	mg/1	9.4	7.1	8.1	8.1	11.1	5.40	8.46	7.85
BOD	"	3.7	1.0	1.8	1.5	5.5	1.0	2.8	2.2
COD	"	74	0.9	17	8.9	18	1.6	10.4	10
Sulphates	"	26	19	24	24	30	18	25	25
Chlorides	"	--	--	--	--	16	9	12	12
MBAS	"	--	--	--	--	.10	.03	.06	.05
NH_3-N	"	0.39	0.16	0.24	0.22	0.68	0.35	0.50	0.50
NO_2-NO_3 N	"	0.41	0.17	0.28	0.28	0.35	0.09	0.20	0.21
Org N	"	0.60	0.04	0.27	0.29	3.23	0.07	0.56	0.33
Total PO_4	"	0.25	0.02	0.12	0.80	0.13	0.05	0.08	0.08
Sol. PO_4	"	0.23	0.02	0.08	0.05	0.09	0.01	0.04	0.04
Iron	"	2.3	0.23	0.98	0.72	1.8	0.55	1.10	1.10
Phenol	ug/1	8	0	2	1	12	0.0	1.9	0.6
Cyanide	mg/1	0.01	0.00	0.00	0.00	0.12	0.00	0.01	0.01
Susp. Solids	"	76	2	22	18	53	4	20	17
Dis. Solids	"	280	160	195	185	235	175	192	185
Alkalinity mg/1 $CaCo_3$		--	--	--	--	117	110	113	113
Temperature	°C	22	11	16.6	18	19	4	11	11

1965 data based on 11 samples except for: susp. solids(8) and dis. solids(7).
1966 data based on 13 samples except for: chlorides(12) and ABS(12).

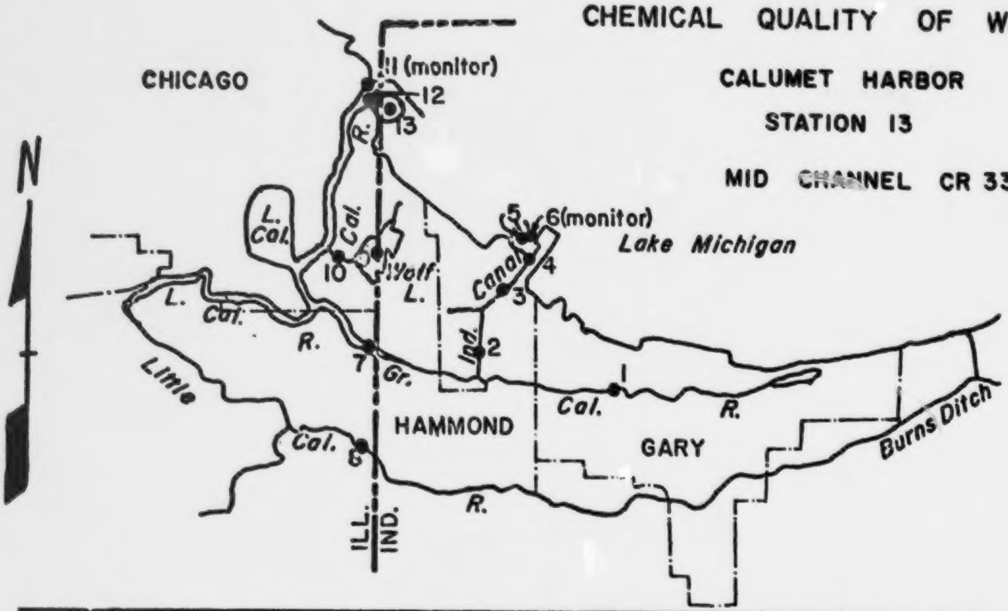
TABLE I - 13

CHEMICAL QUALITY OF WATER

CALUMET HARBOR

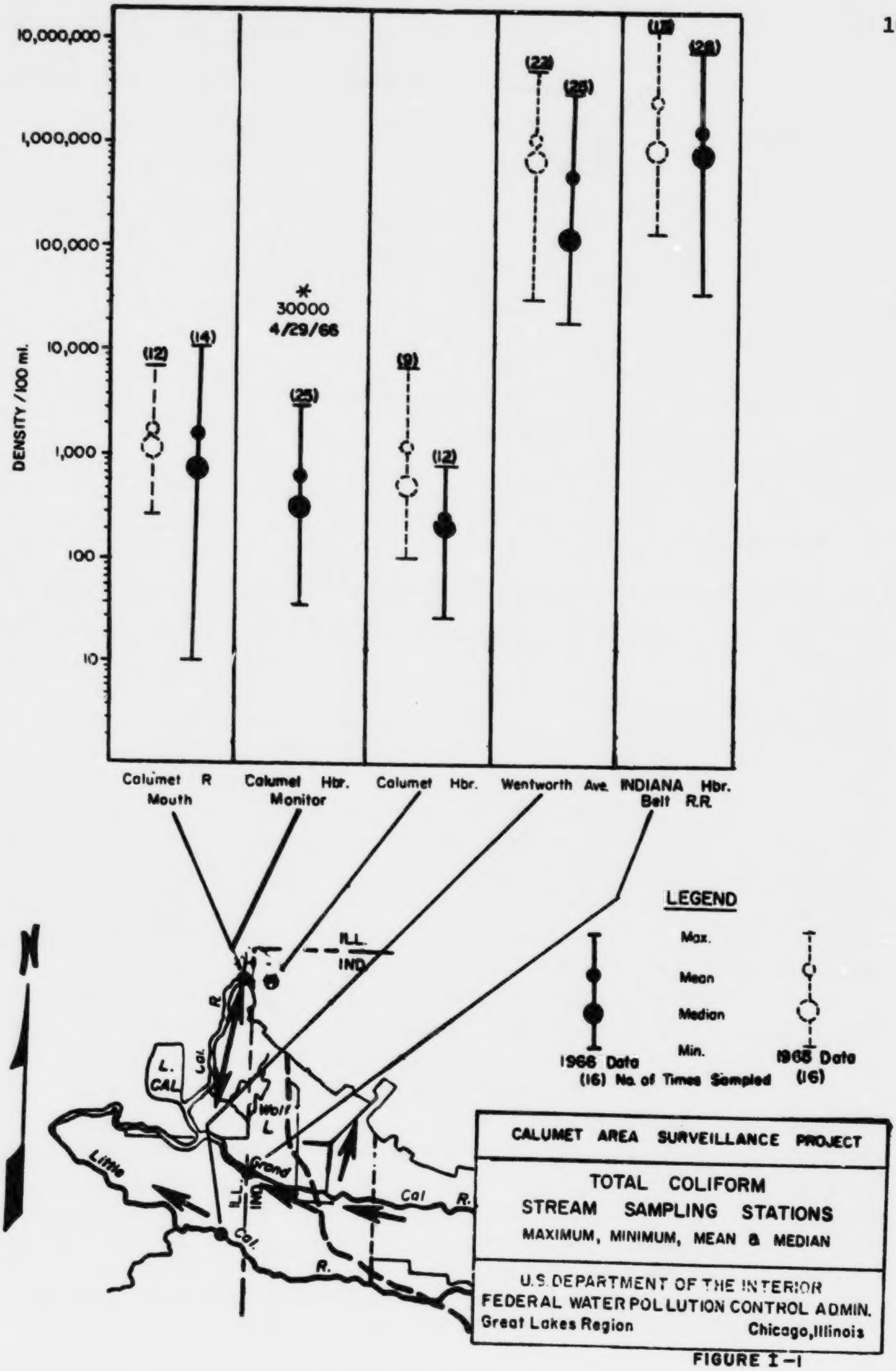
STATION 13

MID CHANNEL CR 334.0



Parameter		June 1965-Nov. 1965 Max	Min	Mean	Median	Jan. 1966-June 1966 Max	Min	Mean	Median
Alkalinity		--	--	--	--	121	107	113	111
pH		8.0	7.7	7.9	7.9	8.1	7.4	7.8	7.8
Conductivity	umho/cm	--	--	--	--	310	270	293	300
DO	mg/1	10	7.0	8.5	8.3	12.2	7.3	9.2	9.3
BOD	"	2.1	1.0	1.5	1.6	4.8	1.3	2.6	2.3
COD	"	26	0.0	9.0	5.9	16	3.0	9.2	10
Sulphates	"	37	19	25	24	26	18	24	25
Chlorides	"	--	--	--	--	14	8	11	11
MBAS	"	--	--	--	--	.09	.03	.05	.04
NH_3-N	"	0.27	0.10	0.19	0.20	0.48	0.24	0.33	0.33
NO_2-NO_3 N	"	0.53	0.17	0.27	0.23	0.35	0.08	0.18	0.16
Org N	"	0.51	0.03	0.26	0.26	0.56	0.10	0.37	0.39
Total PO_4	"	0.78	0.02	0.15	0.06	0.10	0.04	0.06	0.06
Sol. PO_4	"	0.29	0.02	0.08	0.04	0.05	0.00	0.02	0.02
Iron	"	1.8	0.09	0.52	0.18	2.1	0.29	0.66	0.48
Phenol	ug/1	3	0	1	0	5.3	0.0	1.3	0.0
Cyanide	mg/1	0.01	0.00	0.00	0.00	0.01	0.00	.002	0.00
Susp. Solids	"	17	1	8	6	46	3	12	9
Dis. Solids	"	195	155	175	170	210	170	190	185
Turbidity	units	--	--	--	--	8.8	1.3	2.6	3.4
Temperature	°C	22	10	16.2	18	18	5	12	14

1965 data based on 10 samples except for: susp. solids(7) and dis. solids(6).
1966 data based on 12 samples except for: turbidity(10).

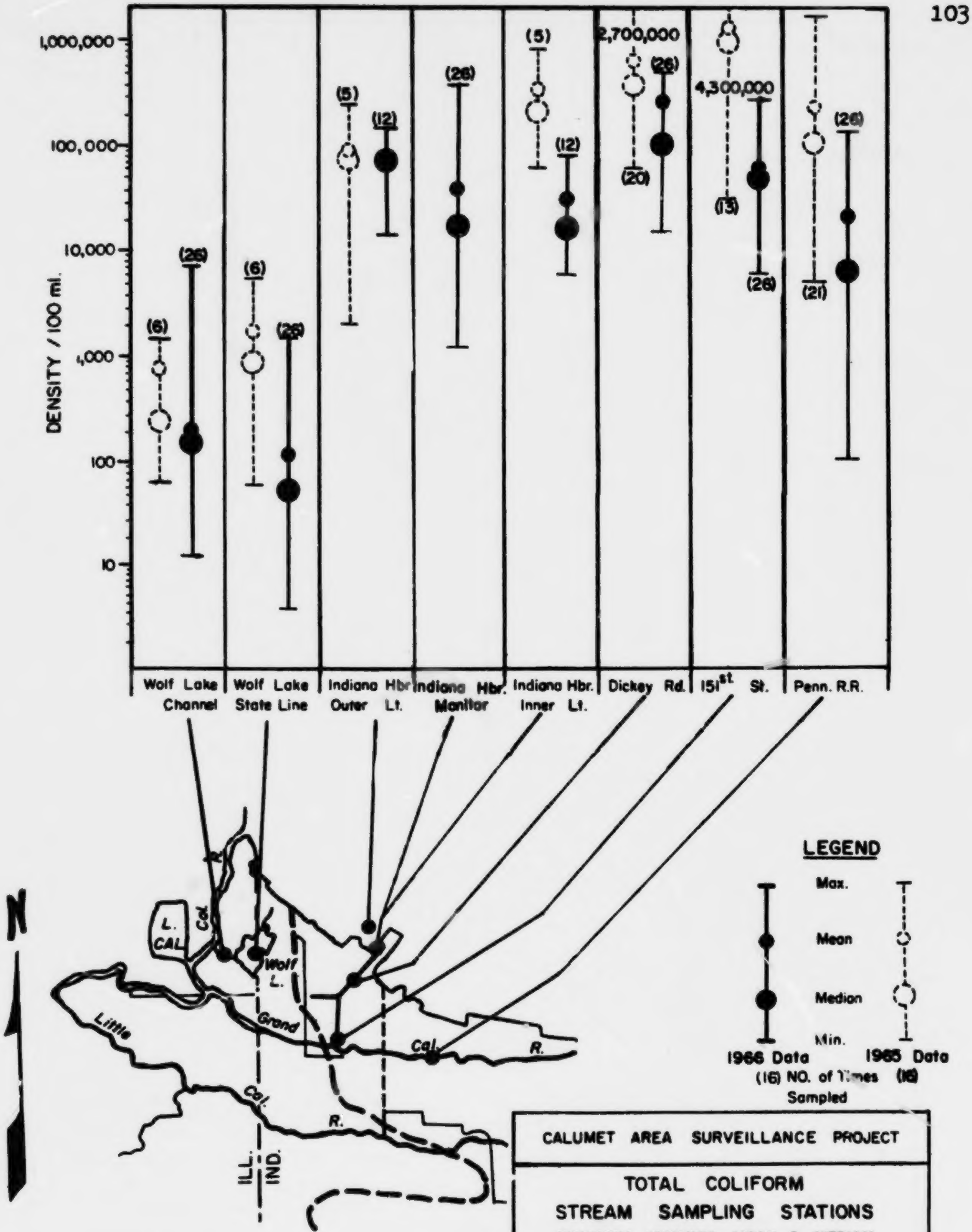


CALUMET AREA SURVEILLANCE PROJECT

TOTAL COLIFORM
STREAM SAMPLING STATIONS
MAXIMUM, MINIMUM, MEAN & MEDIAN

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN.
Great Lakes Region Chicago, Illinois

FIGURE I-1

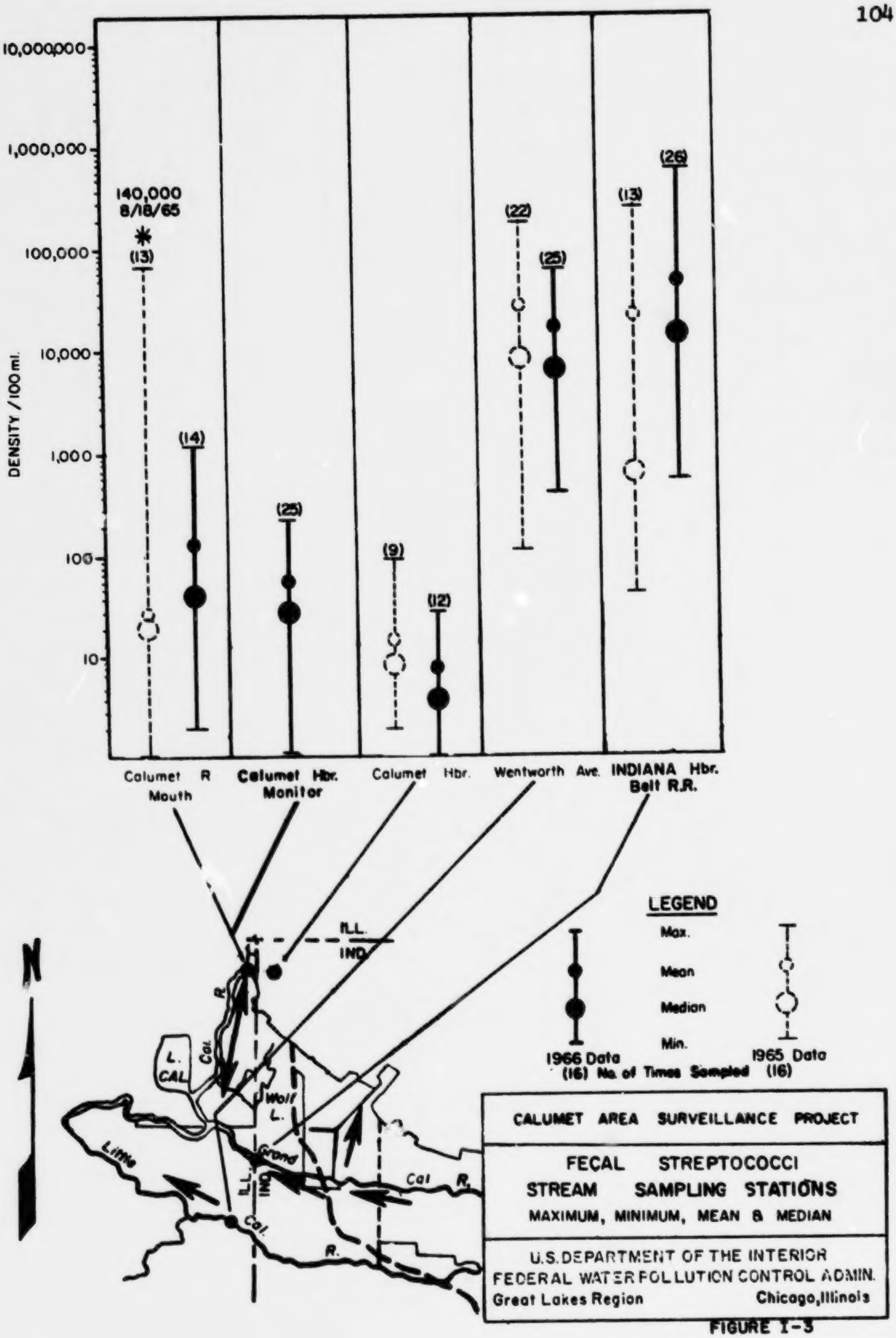


CALUMET AREA SURVEILLANCE PROJECT

TOTAL COLIFORM
STREAM SAMPLING STATIONS
MAXIMUM, MINIMUM, MEAN & MEDIAN

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN.
Great Lakes Region Chicago, Illinois

FIGURE I-2

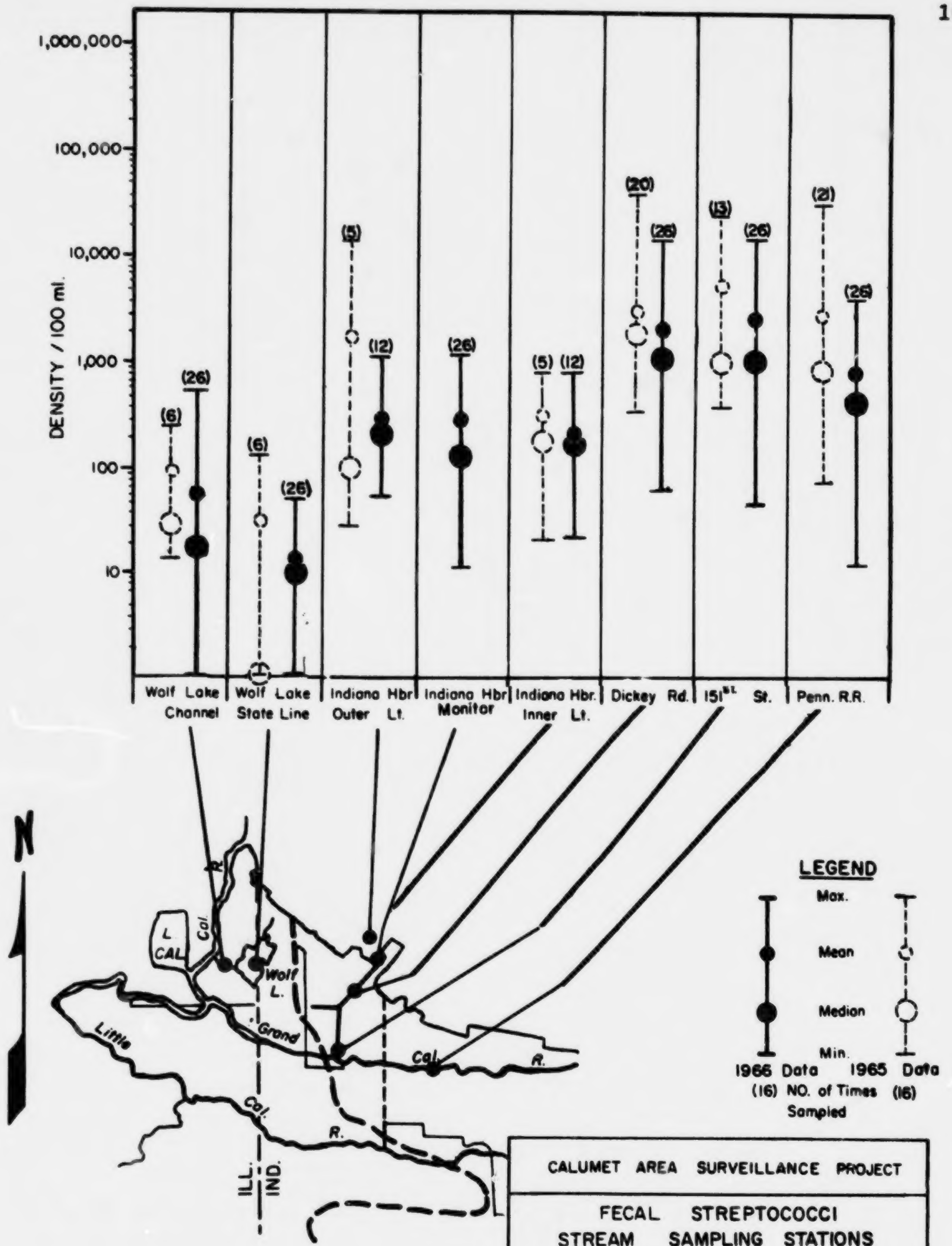


CALUMET AREA SURVEILLANCE PROJECT

FECAL STREPTOCOCCI
STREAM SAMPLING STATIONS
MAXIMUM, MINIMUM, MEAN & MEDIAN

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN.
Great Lakes Region Chicago, Illinois

FIGURE I-3

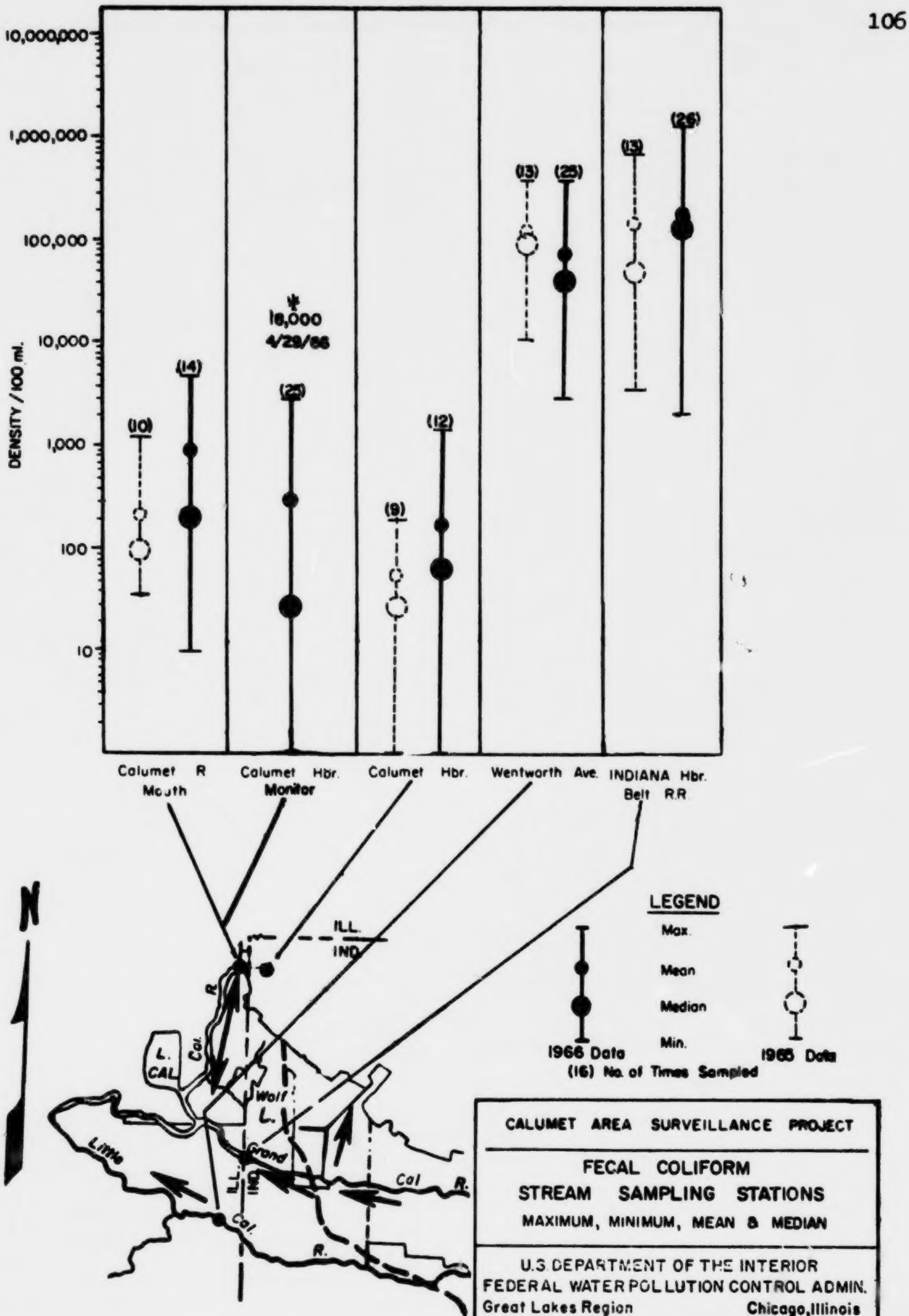


CALUMET AREA SURVEILLANCE PROJECT

FECAL STREPTOCOCCI
STREAM SAMPLING STATIONS
MAXIMUM, MINIMUM, MEAN & MEDIAN

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN.
Great Lakes Region Chicago, Illinois

FIGURE I – 4

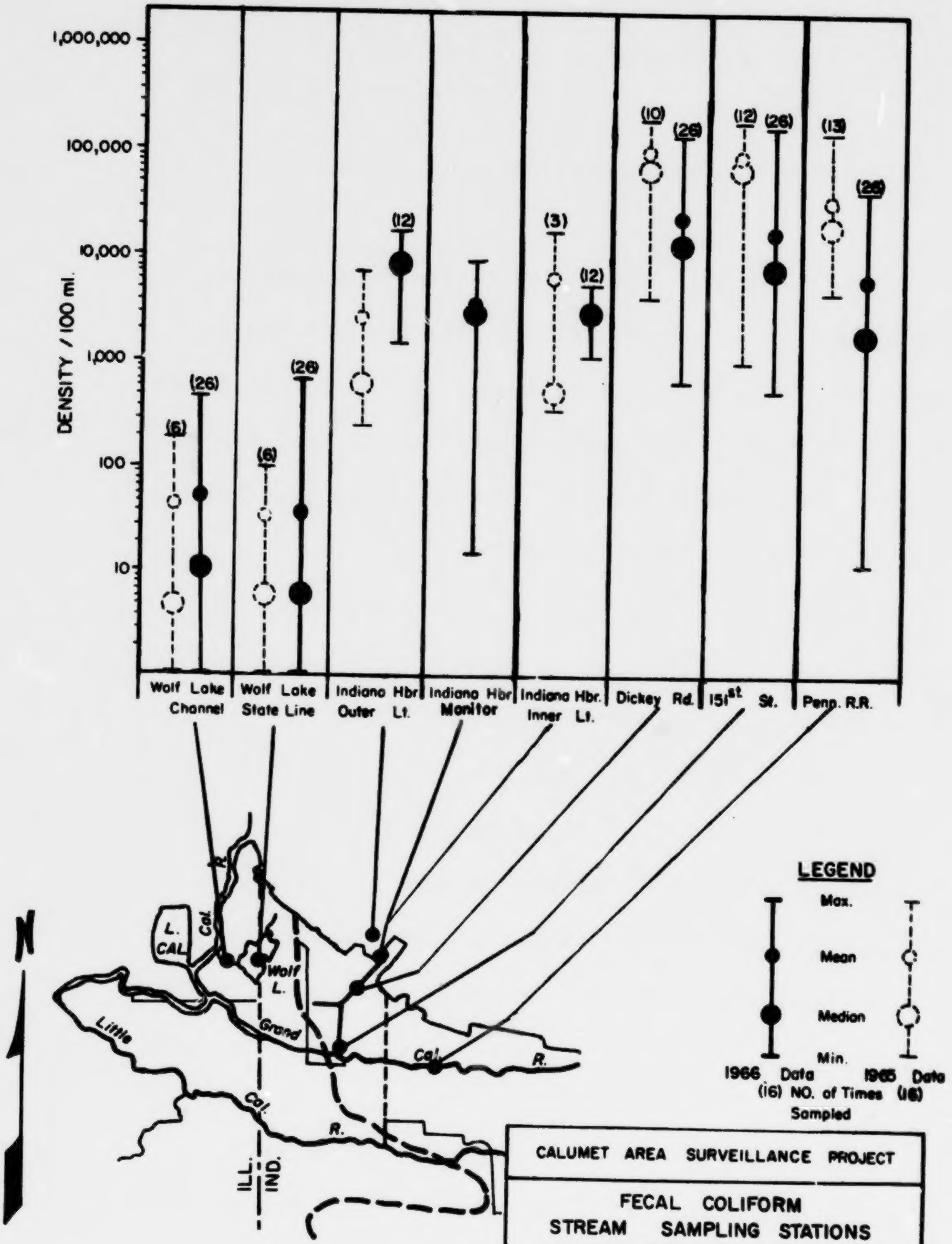


CALUMET AREA SURVEILLANCE PROJECT

FECAL COLIFORM
STREAM SAMPLING STATIONS
MAXIMUM, MINIMUM, MEAN & MEDIAN

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN.
Great Lakes Region Chicago, Illinois

FIGURE I - 5



CALUMET AREA SURVEILLANCE PROJECT

FECAL COLIFORM
STREAM SAMPLING STATIONS
MAXIMUM, MINIMUM, MEAN & MEDIAN

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN.
Great Lakes Region Chicago, Illinois

FIGURE I-6

PART II - BEACH SAMPLING PROGRAM

Microbiological information is based on sampling of Lake Michigan beaches in the Calumet Area between May 31 and September 15, 1966. Samples collected by the Surveillance Project were processed in the GLIRBP Laboratories by means of the membrane filter (MF) method to determine total coliform, fecal coliform and fecal streptococci.

Seven Lake Michigan beaches in the Calumet Area were sampled during the 1966 bathing season. The beaches sampled were Rainbow, Calumet Park Inner and Calumet Park Outer, in Illinois. Rainbow beach was sampled at 75th Place and 77th Place and Calumet Park Inner beach at 99th and 100th Streets. Hammond, Whiting, E. Chicago and Wolf Lake at 121st Street were the Indiana beaches sampled. Wolf Lake was not included in the beach sampling program during the 1965 season.

Procedure

Samples were obtained in four feet of water at elbow depth, approximately 18" below the surface. The samples were immediately stored in an ice chest until processed at the laboratory. The sampler recorded the following information at the time of collecting the sample: number of bathers within a one hundred foot radius; air temperature, water temperature, wind speed and direction; cloud cover and weather conditions; and surf conditions. All samples were processed on the same day that they were taken.

The laboratory methods followed are in accordance with the procedure established in "Standard Methods for the Examination of Water and Wastewater" (12th Ed.). Fecal coliform determinations were made by the MF method, using M-FC broth base (Difco) with Rosolic acid as an indicator. This method was developed by Geldreich et al. at the Robert A. Taft Sanitary Engineering Center (Geldreich et al. '65, J.A.W.W.A., 57: 2: 208-214, Feb).

Data Analyses

Comparisons of the 1965 and 1966 data for total coliform, fecal streptococci and fecal coliform densities are shown graphically for each beach in Figures II-1, II-2 and II-3. It should be noted that a greater number of samples were collected and analyzed in 1966 than in 1965.

The maximum, minimum, arithmetic mean and median densities for total coliform at Rainbow and E. Chicago beaches are approximately the same as in 1965 (Figure II-1). Calumet Park Inner and Outer beaches show slightly lower counts for total coliform in 1966, while Hammond and Whiting beaches are markedly higher. The maximum values as shown in Figure 1 indicate that Hammond and Whiting beaches are subject to periods of extremely heavy pollution.

Fecal streptococci are an indication of possible contamination of the water from domestic sewage. Fecal streptococci densities for 1965 and 1966 are compared graphically in Figure II-2. The maximum and mean counts for the beaches at Calumet Park Outer, Hammond, Whiting and E. Chicago are considerably higher than in 1965, indicating that the beaches are subject to contamination from domestic wastes.

The beaches were sampled 27-29 times during the 1966 season for fecal coliform counts. Figure II-3 shows a graphic comparison of the 1965 and 1966 findings. It should be noted that there were only four samples in 1965 and that these were at the end of the season, when temperatures were lower and beach usage less. The maximum and mean fecal coliform counts are higher in 1966 at every sampling point. Thirty-three percent of the samples collected at Hammond and 22% of the Whiting beach samples had counts of more than 10,000 fecal coliform per 100 ml.

Wolf Lake at 121st was not sampled in the 1965 season, but was sampled 32 times in 1966. The total coliform counts ranged from a maximum of 4,400 to a minimum of 6, with the median 230 and the mean 525. Fecal streptococci counts ranged from less than 1 to 380, with the mean 32 and the median 10. Twenty-seven samples for fecal coliform determinations ranged from 2 to 1,100, with the mean 79 and the median 10. These values indicate that the lake is relatively free of pollution and most of the bacteria probably originate with the bathers using the beach.

The criteria for determining satisfactory water quality for bathing at the beaches in the Calumet Area are:

a. The water quality is satisfactory if MF coliforms are less than 1,000 and MF fecal streptococci are less than 100.

b. The water quality is satisfactory if MF coliforms are between 1,000 and 5,000 and MF fecal streptococci are less than 20.

These standards have been applied to the data collected at the beaches in the Calumet Area for the 1966 swimming season. Table II-1 gives the number and percent of times water quality at beaches did not meet the criteria.

TABLE II-1

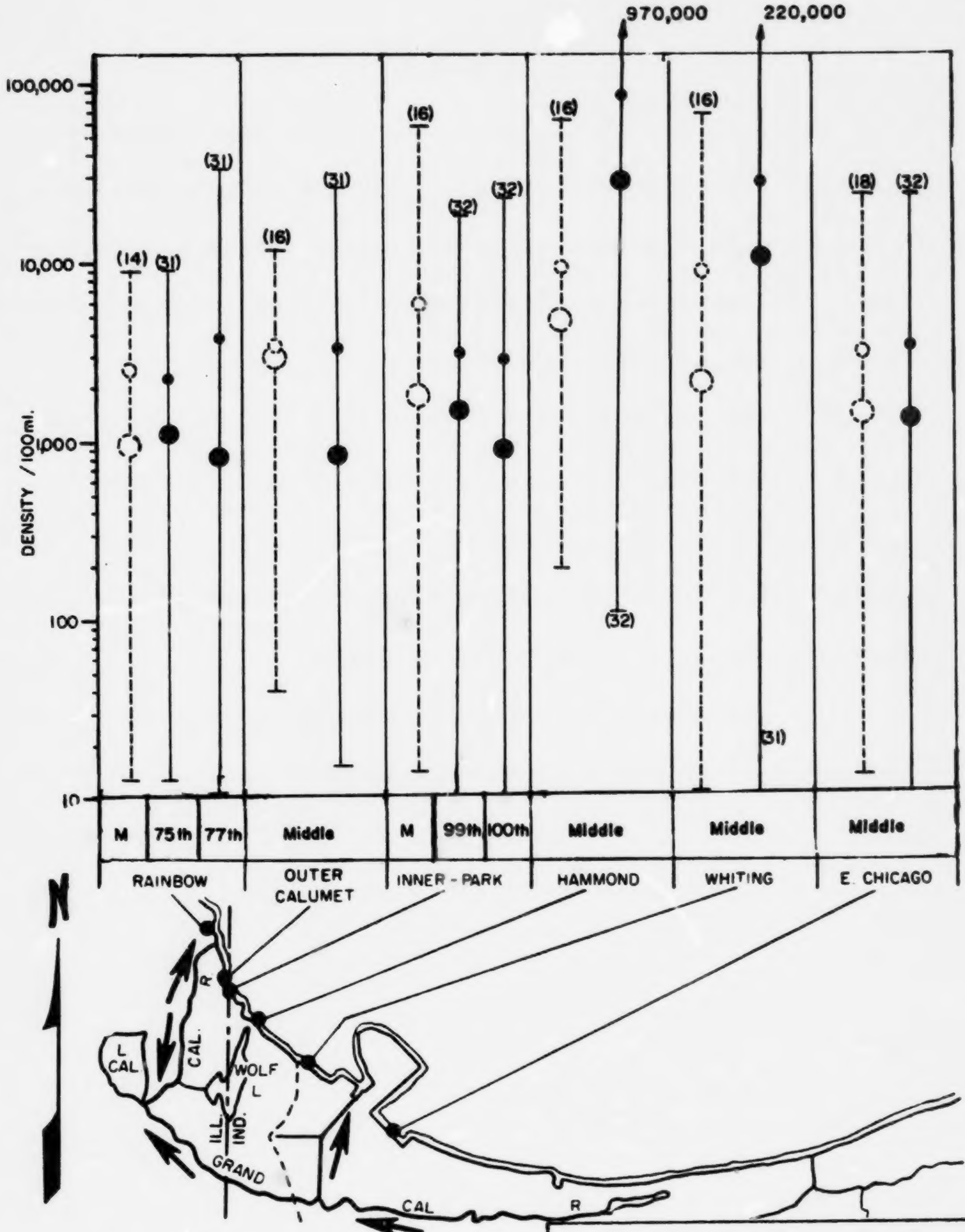
	1965		1966	
Beach	No. of times criteria not met	% of time criteria not met	No. of times criteria not met	% of time criteria not met
Rainbow 75th	10	74	10	32%
77th			13	42%
Calumet Outer	9	57	16	51%
Calumet Inner 99th	15	91	14	43%
100th			12	37%
Hammond	16	100	24	75%
Whiting	10	60	24	77%
E. Chicago	11	61	16	50%
Wolf Lake	-	-	3	9%

From this table it is clear that the beaches were somewhat cleaner in 1966 than they were in 1965, but that significant pollution still exists, especially at the Hammond and Whiting beaches, which met the criteria less than one-quarter of the time.

Figures II-1, II-2 and II-3 indicate that fecal coliform and fecal streptococci did not decline as much as the total coliform counts and that on certain days there were extremely high counts at several beaches. This indicates that much of the pollution is animal in origin and fairly fresh. It may have originated from bathers using the beaches or from boats and offshore shipping.

No correlation was found between the coliform counts and rainfall which would cause local drainage and possible outflows from combined sewers. It must be noted, however, that the 1966 bathing season was unusually dry and, therefore, this study is not conclusive.

It was noted that 75% of the high counts occurred when the wind had an easterly component. This is probably due to the higher wave action, which is associated with easterly winds. The waves tend to stir up the bottom.



LEGEND

(16) No. Times Sampled

- Max.
- Mean
- Median
- Min.

1965 Data

(16)

- Max.
- Mean
- Median
- Min.

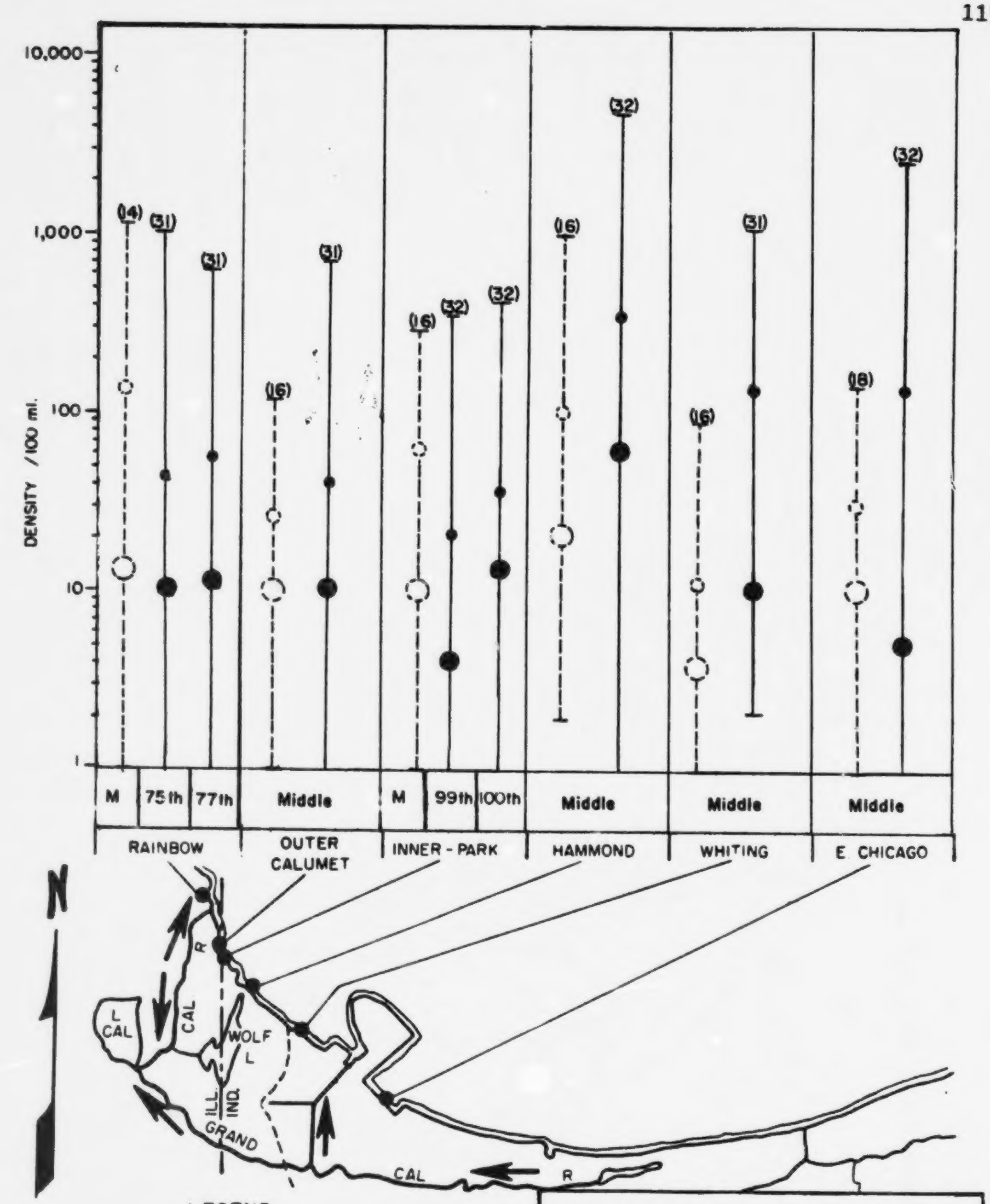
1966 Data

CALUMET AREA SURVEILLANCE PROJECT

BEACH SAMPLING – TOTAL COLIFORM
MAXIMUM, MINIMUM, MEAN & MEDIAN
JUNE – SEPT. 1966

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN.
Great Lakes Region Chicago, Illinois

FIGURE II-1

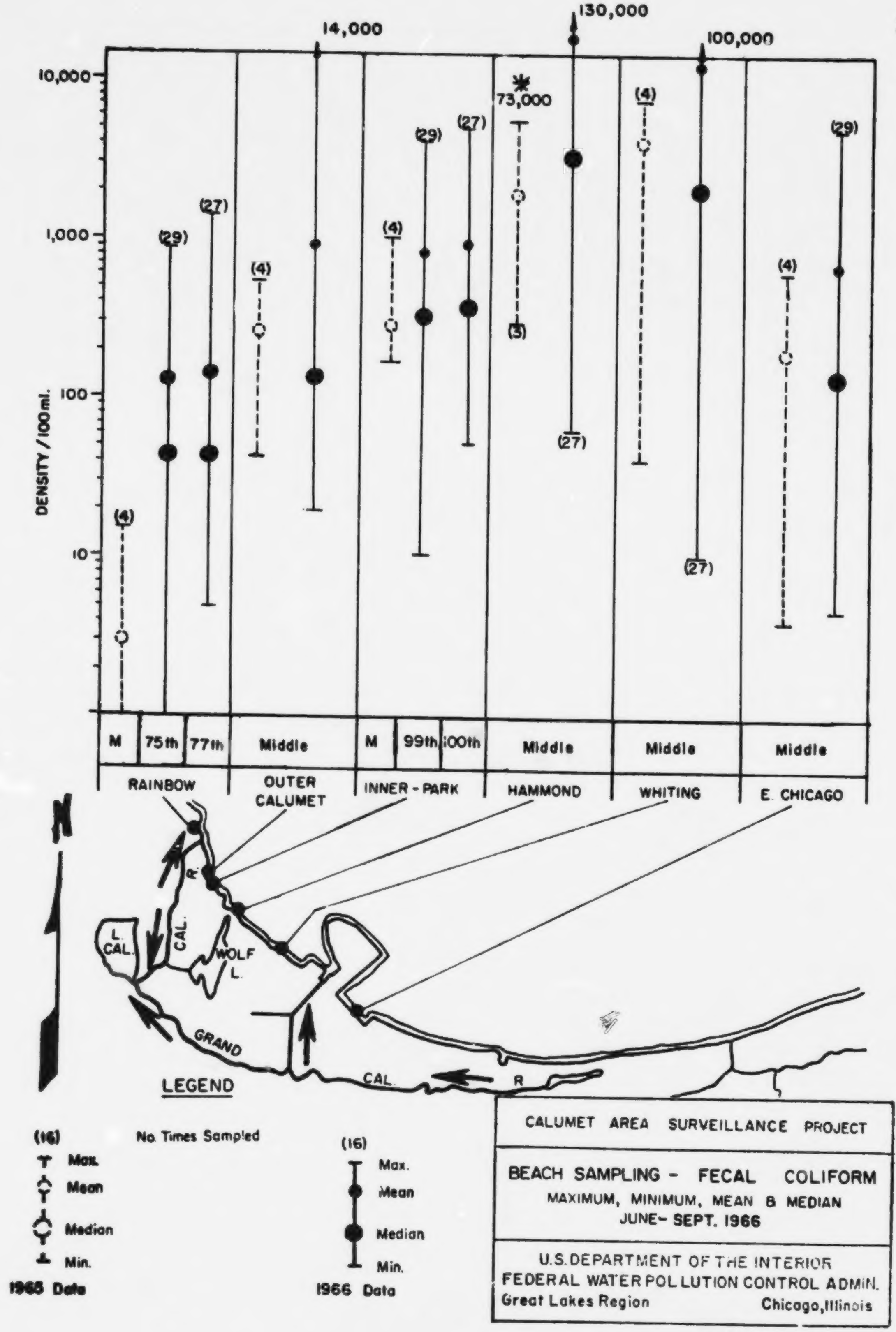


CALUMET AREA SURVEILLANCE PROJECT

BEACH SAMPLING - FECAL STREPTOCOCCI
MAXIMUM, MINIMUM, MEAN & MEDIAN
JUNE - SEPT. 1966

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN.
Great Lakes Region Chicago, Illinois

FIGURE II-2



CALUMET AREA SURVEILLANCE PROJECT

BEACH SAMPLING - FECAL COLIFORM
MAXIMUM, MINIMUM, MEAN & MEDIAN
JUNE- SEPT. 1966

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN.
Great Lakes Region Chicago, Illinois

FIGURE II-3

R. J. Bowden

PART III - AUTOMATIC MONITORING

Description of Facilities

At present there are two automatic water quality monitoring stations in operation, one at Calumet Harbor and one at Indiana Harbor. These instruments, manufactured by the Schneider Instrument Company of Cincinnati, Ohio, consist of three main elements: the flow cells, the electronic circuitry and the data recorder.

A flow cell consists of a tapered cylindrical chamber through which water from the river is continuously pumped. Electrochemical probes which are capable of detecting changes in the chemical properties of the water can be inserted into the cell. These probles send an electric signal to the electronic circuitry portion of the monitor, where it is amplified, modified, displayed on a galvanometer and sent to the data recording section of the monitor.

Each monitor has eight flow cells so that it is capable of handling a minimum of eight parameters. Some parameters such as temperature can be put in the same flow cell with another parameter, so that the flow cells can handle more than eight parameters.

The electronics section of the monitor consists of separate circuits for each parameter. Each of these circuits includes several potentiometers and a galvanometer which can be calibrated to show the value of the parameter at all times. Compensation circuits are included so that parameters that are dependent upon other parameters can be measured on a uniform basis. For example, the conductivity parameter has a temperature compensation circuit so that the conductivity is always recorded as 25°C conductivity. The electronics section has eight cubicles so that it is limited to eight parameters. An additional section would be required to accommodate more than eight parameters.

The recorder section takes signals from the electronic circuits, converts them into mechanical energy and prints the data on a chart which is moving at the rate of one inch per hour. The value of each parameter is recorded once every 6 minutes. The recorder has twelve channels and therefore has the capacity to handle twelve parameters.

At present four parameters are being measured at each monitor. These include temperature, specific conductivity, pH and dissolved oxygen. These are being measured primarily because they are the ones for which reliable probes have been developed. Probes are being developed for sulphates and chlorides. These will be added to each monitor as soon as they become available.

Evaluation of Results

At its present stage of development the automatic monitoring program is not producing up to its full potential. There are two basic reasons for this; one is that the parameters being measured are not the critical pollution parameters in the area, and the second is that, at present, the data is not presented in a form that permits immediate investigation of significant variations in the parameters being measured.

Except for some initial problems, the monitors have demonstrated their ability to operate reliably and continuously over a considerable period of time with a minimum of maintenance. As indicated in Figures III-1 through III-4, the data has a reasonable range and is in reasonable agreement with the results of our weekly sampling program. Much of the variation from the weekly sampling results can be explained by the fact that the samples were not taken at exactly the same point or depth as the monitor intake. In the future, weekly samples for full laboratory analysis will be taken directly from the flow cells in the monitor.

The purpose of continuous monitoring is not to establish water quality. A weekly sampling program is more suitable for this purpose because of the great number of analyses that can be run in the laboratory. The primary purpose of the monitor is to give immediate indication and warning of changes in the water quality so that action can be taken to determine the cause of the change and so that downstream users can be warned if necessary. Due to the fact that the data is stored on a chart and is not immediately available unless the monitor is attended at all times, this utilization has not been realized.

Proposed Improvements

The addition of the ferric iron and sulphates parameters should provide a more direct measurement of the industrial pollution that is predominant in the area.

A central station to which all monitors will telemeter their data is planned. The data will be continuously displayed so that any deviations in water quality could be instantly detected and investigated. In addition, each monitor will be equipped with an automatic sampler which will take a sample if any parameter exceeds certain limits and will flash a warning in the central station.

Eventually there will be a network of six monitors in the area. The central station will receive the data from each of these stations, display it and store it in a computer for analysis. This will give the project the ability to detect and immediately react to changes in water quality in the area.

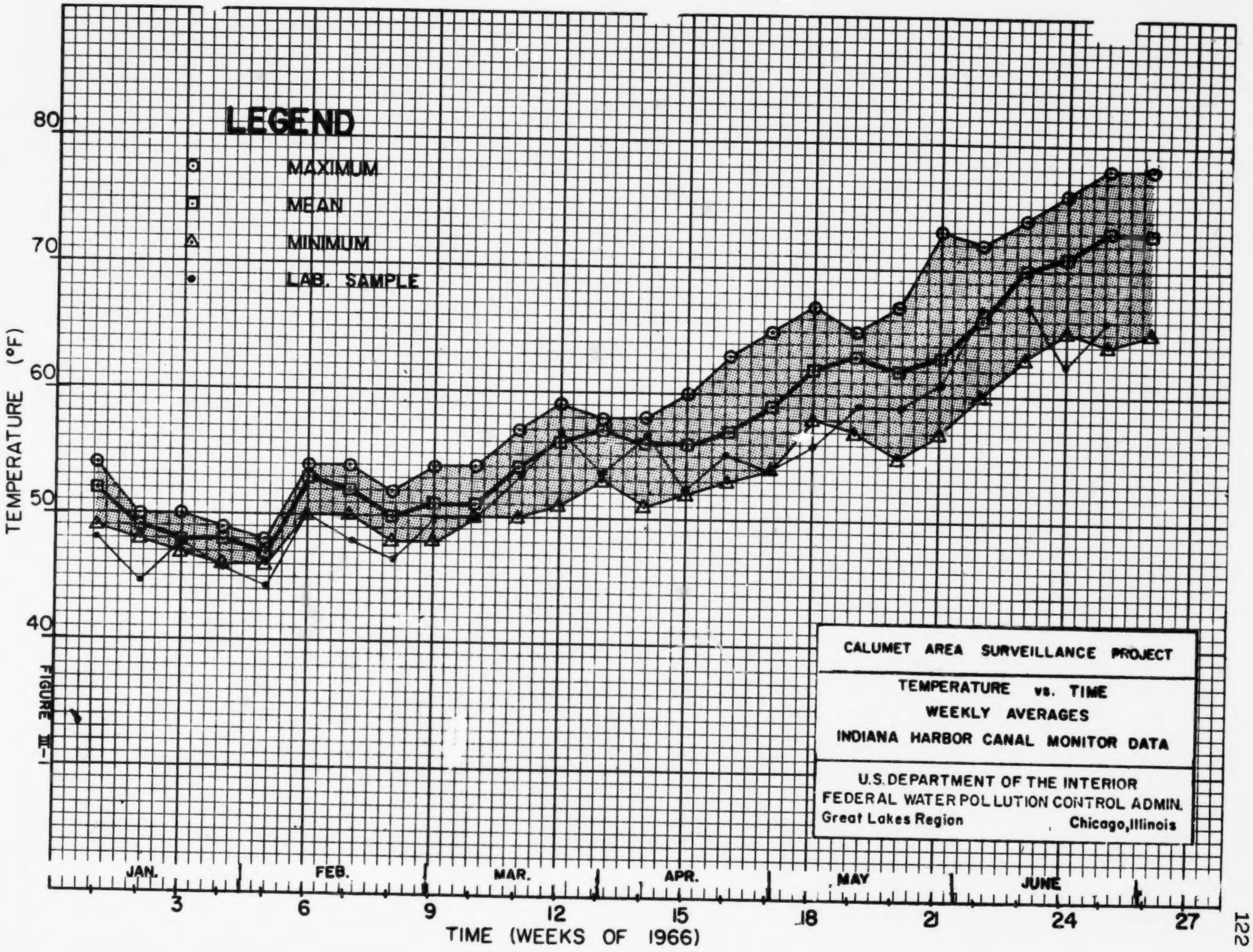

LEGEND
⊙ MAXIMUM
⊡ MEAN
△ MINIMUM
• LAB. SAMPLE
TEMPERATURE (°F)
80
70
60
50
40
JAN.
FEB.
MAR.
APR.
MAY
JUNE
3
6
9
12
15
18
21
24
27
TIME (WEEKS OF 1966)
CALUMET AREA SURVEILLANCE PROJECT
TEMPERATURE vs. TIME
WEEKLY AVERAGES
INDIANA HARBOR CANAL MONITOR DATA
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN.
Great Lakes Region
Chicago, Illinois

FIGURE III-1

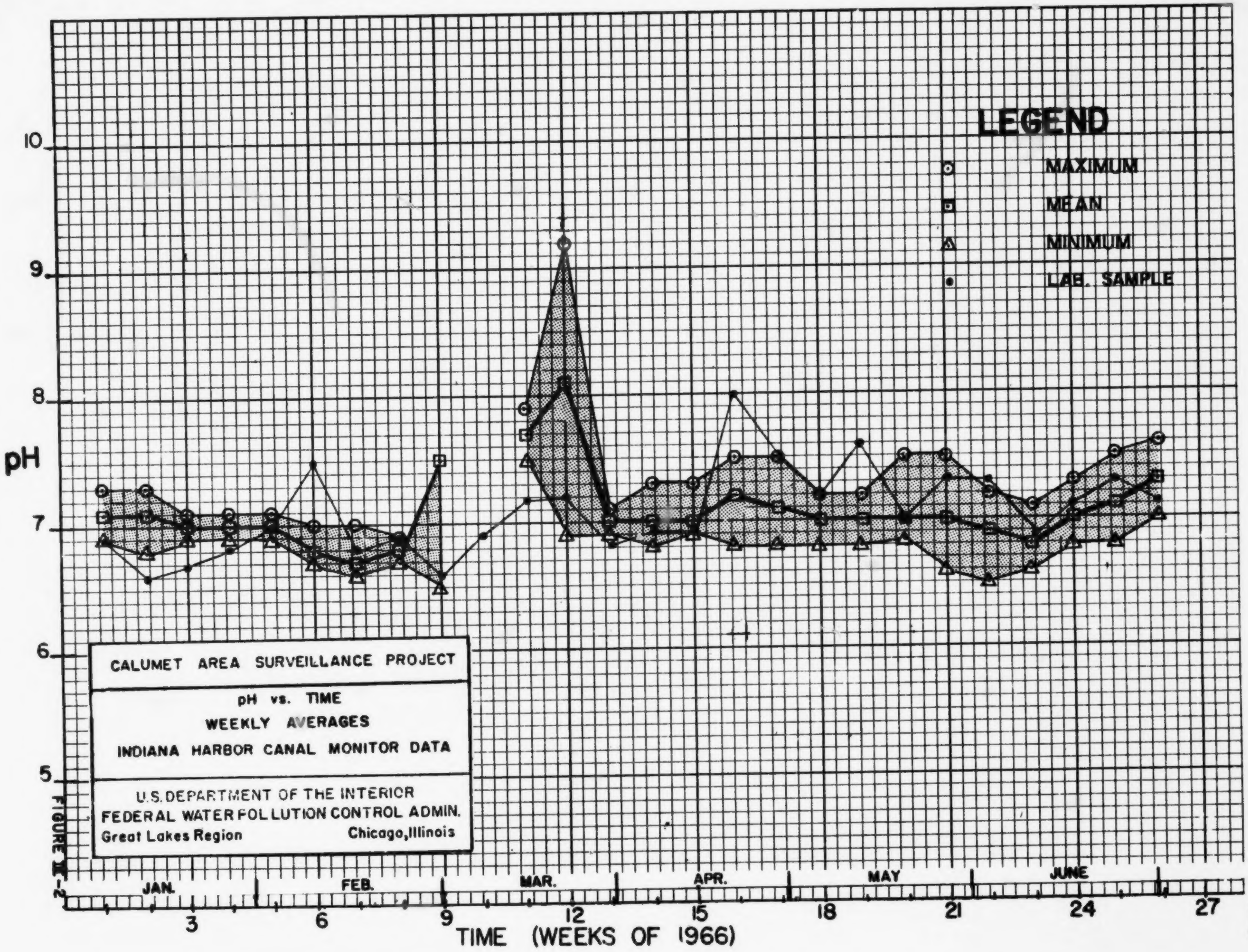

LEGEND
⊙ MAXIMUM
⊡ MEAN
△ MINIMUM
• LAB. SAMPLE
CALUMET AREA SURVEILLANCE PROJECT
pH vs. TIME
WEEKLY AVERAGES
INDIANA HARBOR CANAL MONITOR DATA
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN.
Great Lakes Region
Chicago, Illinois
pH
10
9
8
7
6
5
JAN.
FEB.
MAR.
APR.
MAY
JUNE
3
6
9
12
15
18
21
24
27
TIME (WEEKS OF 1966)

FIGURE III-2

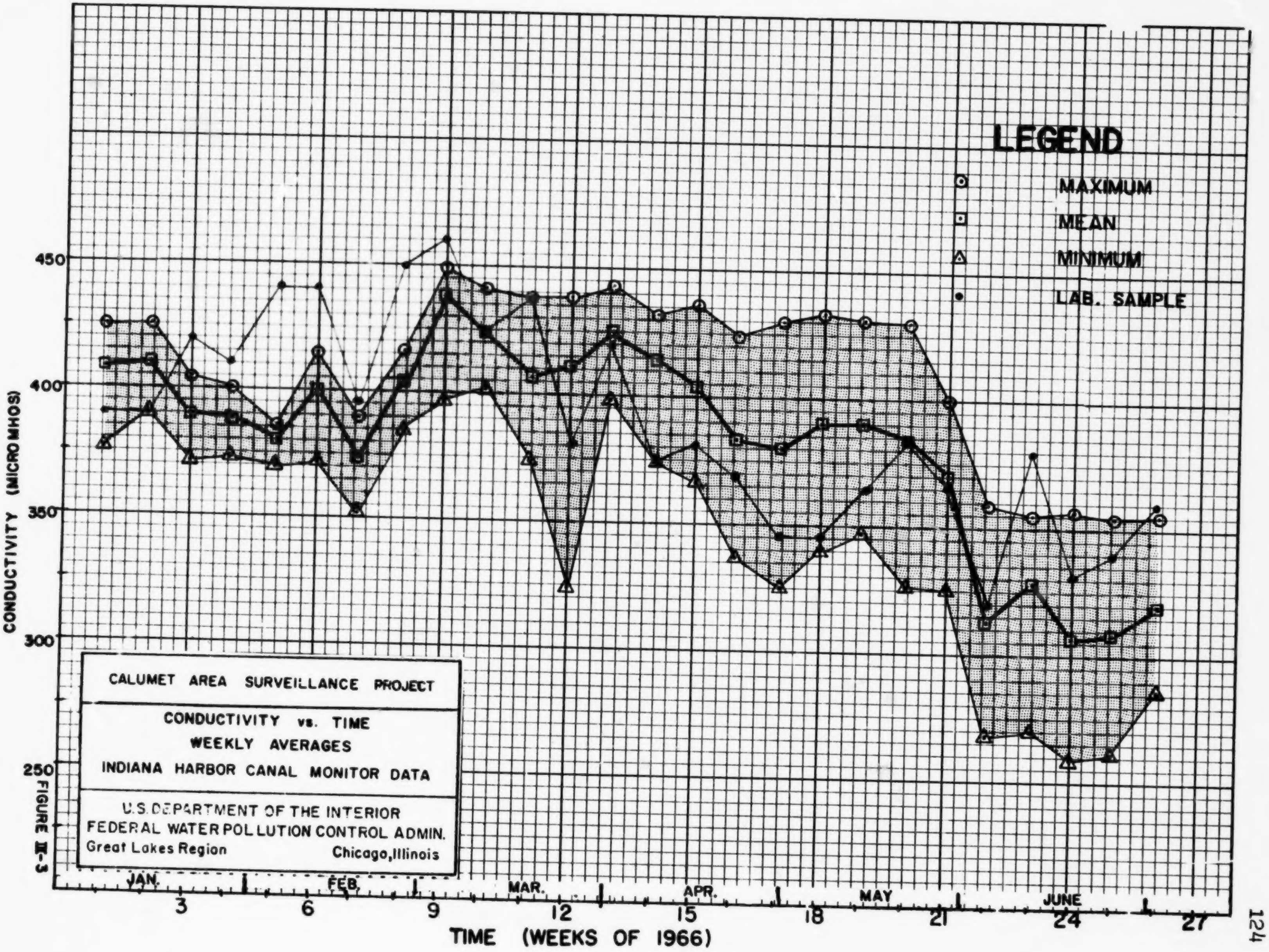
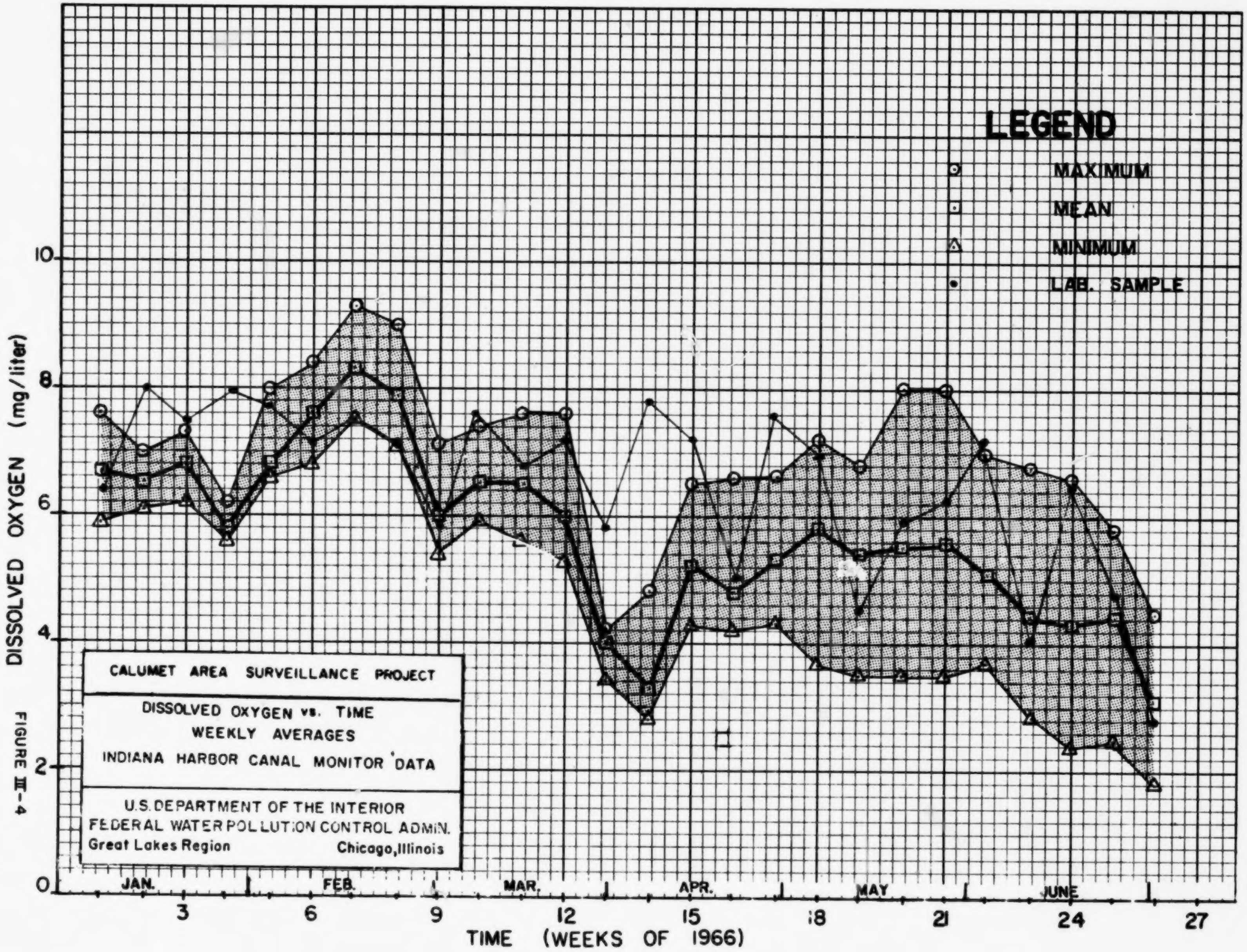


FIGURE III-3

CALUMET AREA SURVEILLANCE PROJECT

CONDUCTIVITY vs. TIME
WEEKLY AVERAGES
INDIANA HARBOR CANAL MONITOR DATA

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN.
Great Lakes Region Chicago, Illinois



CALUMET AREA SURVEILLANCE PROJECT

DISSOLVED OXYGEN vs. TIME
WEEKLY AVERAGES
INDIANA HARBOR CANAL MONITOR DATA

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN.
Great Lakes Region Chicago, Illinois

FIGURE III-4

ADDENDUM

COMPARISON ON USE OF DENDY SAMPLERS AND OTHER BOTTOM SAMPLERS

by

H. J. Fisher

Chief Biologist

During November 1965, samples were collected at the same stations with the Dendy sampler and the Petersen dredge or the Eckman dredge by personnel of the Calumet Area Surveillance Project. The Dendy sampler used plates representing sand, sawdust, or shell substrate. All samples were presented to the biological laboratory of Great Lakes-Illinois River Basins Project for analysis.

Identification of organisms found in each sample was completed during the summer of 1965. Results are shown in the table at the end of this report.

Discussion

The purpose of this brief study was to determine the correlation, if any, between the effectiveness of sampling macroorganisms by the Dendy sampler with that of regular bottom samplers, that is, the Eckman dredge and the Petersen dredge.

Reference to the table indicates that there was little correlation between the number of individuals and species collected by the Dendy sampler, set at sites above the bottom, with those collected by the Eckman or Petersen dredge from the bottom. In most samples, the numbers of individuals and species collected by either of the latter two samplers exceeded those collected by the Dendy sampler.

Only those samples collected on the bottom by Dendy compare somewhat with bottom samples collected by the other bottom samplers at the same station.

The numbers of the tubificidae, pollution tolerant worms, collected by the Eckman or Petersen dredge far exceeded those collected by the Dendy sampler on the bottom at the following stations: Grand Calumet and Indianapolis Boulevard and Grand Calumet and Industrial Highway. Only at the Calumet River Bridge Street Station did the number of tubificidae collected by the Dendy sampler on the bottom exceed the numbers of these sludge worms taken by the regular bottom samplers.

RESULTS OF DENDY SAMPLES COMPARED TO BOTTOM SAMPLES

Location	Type of Dendy	Depth of Dendy Sample	Type of Organisms	No. of Organisms	Organisms in Bottom Samples	No. of Organisms
Calumet River	1. Sawdust	27' above	No organisms found	-	Hirudinea	2
106th St.	2. Sand	bottom	Zygaptera	1	Oligochaeta	3
					Tubificidae	364
Little Calumet River	Sawdust	1½' above	No organisms found	-	Tubificidae	6976
Ashland Avenue		bottom				
Little Calumet	1. Sawdust	1' above	1. Tendipedidae	38	Tubificidae	275
Wentworth Avenue	2. Sand	bottom	2. Tubificidae	1	Nematoda	1
			Tendipedidae	28	Tendipedidae	35
Calumet River	1. Sand	17'above	1. Tubificidae	48	Oligochaeta	602
Torrence Avenue	2. Sawdust	bottom	2. No organisms found	-		
Grand Calumet and	1. Sand	on bottom	1. Physa	10	Physa	4
Indianapolis Blvd.	2. Sawdust-shells		Tubificidae	16	Tubificidae	323
	3. Sawdust		Tendipedidae	18	Tendipedidae	2
			2. Lyanea	27		
			Tubificidae	36		
			Tendipedidae	9		
			3. Tubificidae	183		
Grand Calumet and	Shell	8" above	Tubificidae	368	Tubificidae	1094
Indiana Harbor Belt R.R.		bottom	Tendipedidae	1	Tendipedidae	55
					Tendipedinae	5
Grand Calumet and	1. Sawdust-shell		1. Physa	1	Tubificidae	968
Industrial Hwy.	2. Sand	on bottom	Tubificidae	266		
			Tendipedidae	2		
			2. Tubificidae	310		

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It is the writer's opinion that the numbers of individuals and the numbers of species of aquatic organisms collected above the bottom by the Dendy sampler did not compare closely with those taken by either the Eckman or Petersen dredge hauls from the bottom in the present study. Although a closer correlation between the results of the methods was noted on samples taken from the bottom, more comparing tests should be made between the Dendy sampler on the bottom with the Eckman or Petersen dredge hauls in order to obtain more reliable comparable results.

It is the writer's opinion that accurate conclusions cannot be made from the one sampling conducted in this study.

Comment by Peggy Harris, Biologist

"Dendy samples leave organisms, such as blood worms, in their natural state of color; however, oligochaetes have the tendency to become clear and jelly-like in consistency and to cling to the plates."

RESULTS OF DENDY SAMPLES COMPARED TO BOTTOM SAMPLES

Location	Type of Dendy	Depth of Dendy Sampler	Type of Organisms	No. of Organisms	Organisms in Bottom Samples	No. of Organisms
Wolf Lake Channel and	1. Sand	1' above	1. Simulidae	125		
Corondolet Ave.	2. Sawdust	bottom	2. No organisms		Pontaporeia	12
					Isopoda	1
					Physa	1
					Gyraulus	2
					Hirudinea	5
					Glossiphonia	2
					Tubificidae	42
					Tendipedidae	67
					Simulidae	101
					Emphemeroptera	2
					Trichoptera	1
Indiana Harbor Canal	1. Sawdust	1' above	1. Tubificidae	31	Tubificidae	232
151st Street	2. Sand	bottom	2. Tubificidae	6	Tendipedidae	2
Grand Calumet River	1. Sand	on bottom	1. Tubificidae	179		
Bridge Street	2. Sawdust		2. No organisms	-	Tubificidae	13
Little Calumet River	1. Sand	14' above	1. Tendipedidae	13	Tubificidae	654
New York Central Bridge	2. Sawdust	bottom	Odonata	1	Tendipedidae	2
			2. Tubificidae	3		
Calumet River at	1. Sand	14' above	1. No organisms found	-	Hirudinea	4
Indiana Avenue	2. Sawdust	bottom	2. Tubificidae	6	Tubificidae	1161
			Tendipedidae	2	Tendipedidae	17
Calumet River 130th Street	Sawdust	-	No organisms found		Tubificidae	24

R. J. Bowden

STATUS REPORT ON THE
CALUMET AREA POST ACTION SURVEILLANCE PROJECT
DEPARTMENT OF THE INTERIOR
FOR THE PERIOD
JULY THROUGH DECEMBER 1966

ILLINOIS-INDIANA

U.S. Department of the Interior
Federal Water Pollution Control Administration
Great Lakes Region, Chicago, Illinois
February 1967

PERSONNEL

Raymond E. Johnson

Project Director until Sept. 23, 1966

Robert J. Bowden

Sanitary Engineer

Acting Director after Sept. 23, 1966

David E. Vaughn

Sanitary Engineer until Aug. 23, 1966

Harold A. Bond

Microbiologist until Sept. 2, 1966

Diane P. Gavel

Chemist

Anne Byrne

Microbiologist after Sept. 19, 1966

Joseph V. Slovick

Aquatic Sampler - Hydraulics Technician

William J. Degutis

Aquatic Sampler - Monitor Technician

Daniel Chorowicki

Aquatic Sampler

Lillian Ehlert

Secretary

R. J. Bowden

INTRODUCTION

This report presents an evaluation of the progress made toward improved water quality in the Calumet area as of December 31, 1966. This evaluation is based on the results of the sampling programs of the Federal Water Pollution Control Administration's Calumet Area Post Action Surveillance Project. The waters reported on include the Grand Calumet River, the Indiana Harbor Canal, Indiana Harbor, the Little Calumet River, Wolf Lake and its outlet and Calumet Harbor.

The cooperation provided by the Indiana Stream Pollution Control Board, the Illinois Sanitary Water Board, the Metropolitan Sanitary District of Greater Chicago, the United States Coast Guard, U. S. Army Corps of Engineers and others in supplying valuable information and facilities is gratefully acknowledged.

R. J. Bowden

BACKGROUND

Authority and Organization

A conference on pollution of the interstate waters of the Grand Calumet River, Little Calumet River, Calumet River, Wolf Lake, Lake Michigan and their tributaries, called by the Secretary of Health, Education, and Welfare under the provisions of Section 8 of the Federal Water Pollution Control Act (33 USC 466 et. seq.) was held in Chicago, Illinois, March 2-9, 1965.

Paragraph No. 14 of the Conclusions and Recommendations of the Conferees for this conference provided that "Surveillance will be the primary responsibility of the Indiana Stream Pollution Control Board, the Illinois Sanitary Water Board and the Metropolitan Sanitary District of Greater Chicago. The Department of Health, Education, and Welfare will make available a resident technical group and visiting groups of experts which will assist the State agencies and the Metropolitan Sanitary District of Greater Chicago at such time as requested by them."

The State of Indiana, on April 6, 1965, and the State of Illinois, on April 16, 1965, requested an extensive sampling program by the Federal Government to monitor the water quality in the Calumet area. The Metropolitan Sanitary District has not formally requested a sampling program, but has requested laboratory assistance in the analysis of samples they have collected and in special studies they have conducted on chlorination of the effluent from their sewage treatment plant. The Calumet Area Surveillance Project was organized in the latter part of June 1965 to fulfill the requirements of paragraph No. 14 and the requests of the States.

On January 1, 1966, the Federal Water Pollution Control Administration was created within the Department of Health, Education, and Welfare and incorporated the surveillance project.

On May 10, 1966, the Federal Water Pollution Control Administration was transferred from the Department of Health, Education, and Welfare to the U. S. Department of the Interior.

Purpose and Scope

The purpose of the Calumet Area Surveillance Project is to assess the progress in the abatement of pollution in the conference area in cooperation with appropriate State and local agencies. This is being accomplished through a sampling program to monitor the water quality at various locations within the conference area and a series of electronic water quality monitors to continuously monitor the water quality at selected key points in the basin. Streamflow measurements are being made so that laboratory analyses in milligrams per liter can be converted to pounds per day. The information obtained through Federal, State and local sampling programs and the information furnished by the industries to the State or other responsible agencies on the quality and quantity of their waste flows are evaluated.

Reports are prepared and presented to the conferees and reconvened conferences on the current water quality and the progress toward abatement of the pollution.

DESCRIPTION OF AREA

The Calumet area is a flat plain located at the southern end of Lake Michigan and includes the Calumet-Little Calumet River system, the Grand Calumet-Indiana Harbor Canal system, Wolf Lake and its outlet. It includes approximately 742 square miles and forms a part of the continental divide between the Mississippi River Basin and the Great Lakes-St. Lawrence River Basin. Approximately 60 percent of the area drains to Lake Michigan and the remaining 40 percent drains to the Mississippi River by way of the Illinois River. Despite this fact, the area is not well drained. There are large, marshy, low-lying areas which are subject to flooding during and after heavy rainfalls. The streams are sluggish and meandering except where they have been artificially maintained and/or supplemented by industrial or municipal waste flows.

The Grand Calumet and the Little Calumet Rivers both traverse the divide. On the Grand Calumet the divide is normally located at the Hammond, Indiana sewage treatment plant outfall. Approximately two-thirds of the effluent flows west into the Calumet River in Illinois and one-third flows east to the Indiana Harbor Canal and Lake Michigan. Rainfall and lake level conditions can cause the divide to shift to either the east or the west.

The location of the divide on the Little Calumet River is not definite and varies over a distance of several miles in the vicinity of Highland, Indiana. The western portion flows to the Cal-Sag Channel in Illinois which connects the system to the Illinois River. The eastern portion flows to Lake Michigan by way of Burns Ditch which discharges to the lake near Ogden Dunes, Indiana.

Flow in the Calumet River is controlled by the O'Brien Lock and is directed from Lake Michigan to the Cal-Sag Channel except during periods of heavy flooding or unusually low lake levels.

The Indiana Harbor Canal which was completed in 1903 connects the Grand Calumet River to Lake Michigan. The Grand Calumet River east of the Hammond Sewage Treatment Plant outfall is tributary to Lake Michigan through the canal.

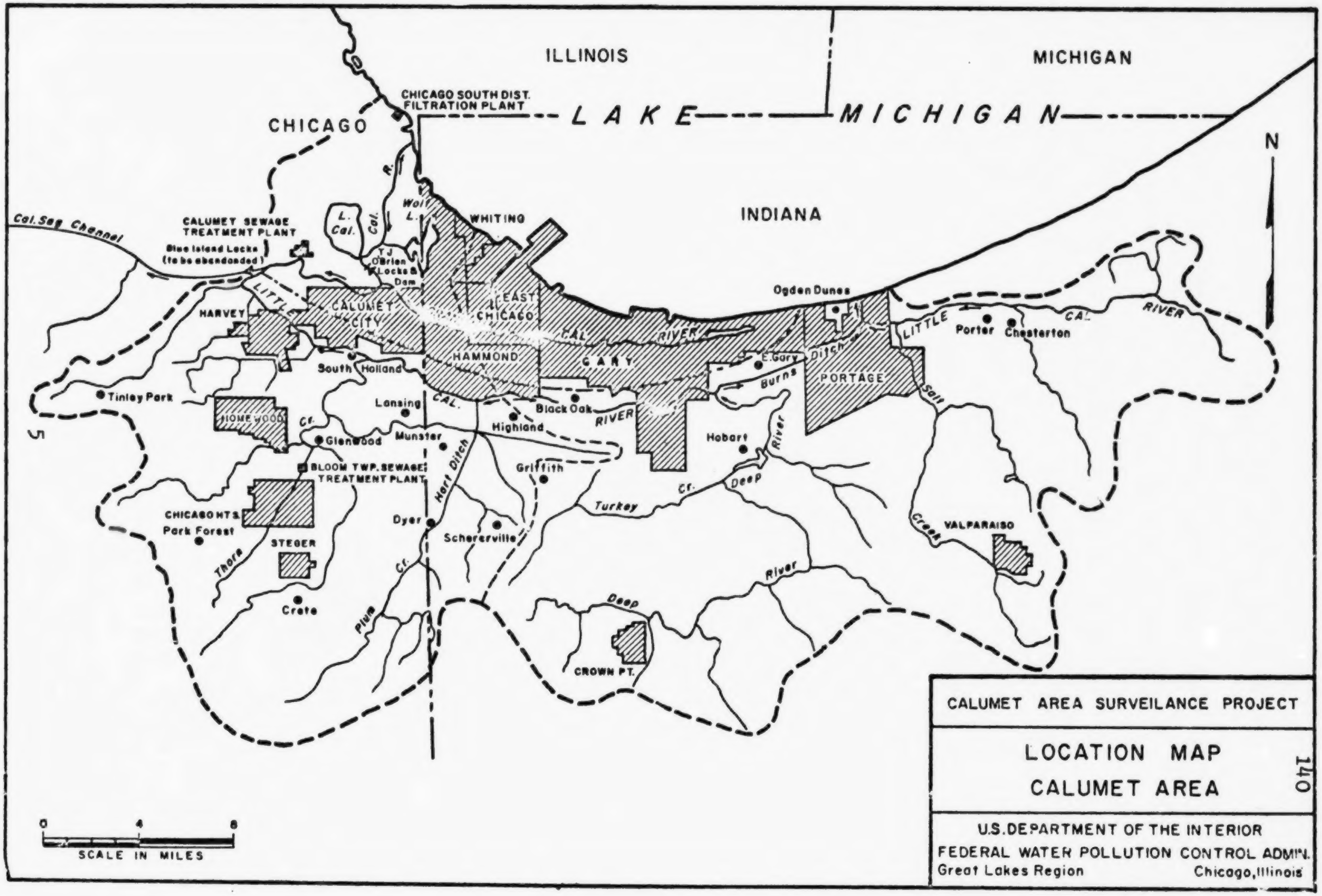
Wolf Lake is located on the Illinois-Indiana State line between Chicago, Illinois, and Hammond, Indiana. The original outlet from Wolf Lake to Lake Michigan has been blocked and an outlet to the Calumet River in Chicago has been constructed. The City of Hammond maintains a park which occupies most of the Indiana shoreline of the lake. This park and the lake are extensively used for recreation. The Illinois portion of the lake is a part of the Wolf Lake Conservation Area.

Cities and Industries

The major population centers in the area are

East Chicago, Gary, Hammond and Whiting, in Indiana; and Calumet City, Chicago Heights and a part of the south side of Chicago in Illinois. The area is highly industrialized. There are ten major steel mills including the United States Steel Corporation's Gary Works, Gary Sheet and Tin Mill, Youngstown Sheet and Tube Company, and Inland Steel Company in Indiana and United States Steel's South Works, the Wisconsin Steel Company, the Interlake Iron Corporation, the Republic Steel Corporation and the Acme Steel Company in Illinois. There are five petroleum refineries including the American Oil Company, the Cities Service Petroleum Company, the Mobil Oil Company, and the Sinclair Refining Company, in Indiana, and the Clark Oil and Refining Co., in Illinois. Other industries include Lever Brothers, Union Carbide Chemical, I. E. Du Pont, M. & T. Chemicals, American Maize, and a large number of smaller concerns.

These industries are located in three major groups. One group is concentrated along the Calumet River in Illinois. Another is along the Indiana Harbor Canal, and the third is in Gary, Indiana, and discharges to the headwaters of the Grand Calumet River. These three groups make the Calumet Area one of the most important industrial centers in the Nation.



CALUMET AREA SURVEILANCE PROJECT

LOCATION MAP
CALUMET AREA

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN.
Great Lakes Region Chicago, Illinois

R. J. Bowden

DESCRIPTION OF PROGRAMS

Stream and Harbor Sampling Programs

During the period July to December 1966 seventeen stream, harbor and water intake stations were sampled on a weekly basis for chemical and microbiological quality. Thirteen of these were sampled during the entire period. The remaining four are lake stations that require a boat for sampling. These were not sampled after October 27, 1966, due to ice and inclement weather on the lake. The results of this program are the basis for this report.

Beach Sampling Program

Sampling on seven beaches in the area was initiated on May 31, 1966, and continued on a twice weekly basis until September 15, 1966. Six of these beaches are located on Lake Michigan and one on Wolf Lake. Five of the beaches were sampled at their mid-points in water approximately four feet deep. Two beaches, Rainbow Beach and Calumet Inner Beach, were sampled at two points each at the one-third points. Samples were collected on

Tuesday and Thursday of each week and analyzed for total coliforms, fecal coliforms and fecal streptococci. This program was coordinated with ~~the~~ beach sampling programs of the Chicago Park District and the Indiana State Board of Health and data was distributed freely among the agencies. The results of the beach sampling program for the 1966 season were presented in the progress report covering the period January to June 1966.

Hydraulic Measurements Program

No gaging stations are maintained by the U. S. Geological Survey in the Grand Calumet-Indiana Harbor Canal drainage system. Therefore, six continuous water level recorders have been installed on these streams. The streams are being gaged at these stations so that rating curves can be developed for each station. The stage vs. discharge relationship in the Indiana Harbor Canal and eastern portion of the Grand Calumet River is seriously distorted by fluctuations in the level of Lake Michigan. Special flow area, velocity and stream slope studies are being made in order to develop flow data for these streams.

Information provided by the U. S. Geological Survey and the Metropolitan Sanitary District will be used as the basis for flow calculations on the Little Calumet River, the Calumet River and Wolf Lake Outlet.

The purpose of this program is to develop flow data for all of the sampling stations in the surveillance area except for those located in Lake Michigan.

Automatic Monitoring Program

Many operations of the industries in the basin require discharge of wastes on a batch basis, and wastes from these tanks may be dumped at any time of the day, week, or month, depending on the needs of the industry. These discharges and accidental spills of oil or other pollutants could pass into Lake Michigan or down the Illinois River unobserved by a once-a-week sampling program.

During November 1965 an automatic water quality monitoring station was installed in Indiana Harbor at the East Breakwall Inner Light. This installation continuously records the dissolved oxygen, pH, conductivity and temperature of the water flowing past this point into Lake Michigan. A complete report on this installation was given in the report covering the period June through November 1965.

A second monitor was installed during August 1966 to measure the same parameters at the mouth of the

Calumet River. This monitor replaces the semi-portable, temporary monitor that had been located there during 1965. A complete report on this new installation is included as an appendix to this report. It is planned to mount the semi-portable monitor in a boat and use it for profile studies of the various streams in the area. This procedure should be of value in pinpointing specific sources of wastes in the area.

An automatic sampling device will be installed on each monitor as soon as it becomes available. This device will automatically collect a sample when one or more of the parameters being monitored exceed certain limits.

This year it is planned to install two additional monitors and a central control station to which all the data will be continuously telemetered. One monitor will be located at Wentworth Avenue on the Little Calumet River and will monitor the quality of the water flowing across the State line at this point. The other will be located on the Grand Calumet River below the industrial complex at Gary, Indiana. This will monitor pollutants discharged to the headwaters of the stream and may enable warnings to be given to downstream uses of the approaching pollution.

Eventually a network of six monitors is planned for the area.

Biological Surveying Program

The kinds and numbers of aquatic plants and animals inhabiting a particular body of water and the stream of lake bottom beneath it, reflect the quality of the water that prevails in the area. Some organisms are capable of withstanding polluted conditions and will multiply rapidly when competition from other less tolerant organisms is eliminated. These pollution tolerant organisms include sludgeworms, bloodworms, leeches, blue-green algae and pulmonate snails. In an unpolluted environment the number of these organisms is restricted by competition from other species, but when the other species are killed off by pollution they multiply rapidly. Therefore, the continuous or sudden introduction of toxic wastes, settleable solids, or oxygen consuming materials alters the composition of the benthic population. A balanced population is not restored immediately upon the return of optimum water quality because of the lengths of the life cycles of those organisms which vary from weeks to years. This fact makes it possible to detect slugs of pollution that have passed through a sampling station.

Fifteen substrate samples of the Dendy type were made and used in the waters of the Calumet area during October through November 1965 on an experimental basis. The results obtained from these samples have been compared with the more standard dredge samples that were taken at the same time. The results of this experiment are not conclusive. Further experimentation with this sampling method is planned next spring.

During July 1966 a biological survey was made of the Calumet and portions of the Little Calumet River and bottom muds were sampled in the Calumet River and the Indiana Harbor Canal to determine the quality of the material dredged from these streams. The results of these surveys are presented as a part of this report.

July - December 1966 Calumet Area Report

CONCLUSIONS

1. The water quality in the Little Calumet River at the State line has greatly improved since 1963, and progress on domestic pollution is still being made. The stream is still polluted and does not meet the recommended

criteria.

2. The water quality in the Grand Calumet River at the State line improved considerably during the period July 1966 to November 1966, but deteriorated badly in December 1966. At no time did the stream meet the recommended criteria.

3. The bacterial quality of the Grand Calumet-Indiana Harbor system has improved since 1965 due to chlorination by municipalities and sewer separation by industries.

4. Industrial pollution of the Grand Calumet-Indiana Harbor system has become more severe since the 1965 conference as evidenced by increased concentrations of iron, phenol, cyanides and other water quality parameters indicative of industrial waste.

5. Wolf Lake is a relatively clean body of water which meets the recommended criteria except for ammonia, pH and MBAS. Occasional detergent spills are the only significant pollution problem.

6. The water quality of municipal intakes in the inner harbor basins (Hammond and East Chicago) meets some of the criteria; however, because of wastes from Indiana Harbor, does not meet the criteria for phosphates, iron, phenols and dissolved solids.

R. J. Bowden

7. The water quality at municipal intakes in open Lake Michigan waters (Dunne Crib and Gary West) meets the recommended criteria except for ammonia and pH.

SPECIAL ADDENDUM

On January 17, 1967, the superintendent of the East Chicago Water Filtration Plant (Station 15) reported that his plant experienced a severe taste and odor problem on the previous weekend. He further stated that taste and odor problems have occurred on several weekends in the past. This was confirmed by the superintendent of the Hammond Water Filtration Plant who stated that he always has taste and odor problems but that they are more severe on weekends.

In order to investigate this problem, special sampling runs were made on Friday, January 20, 1967, Saturday, January 21, and Sunday, January 22. The Indiana Harbor Canal was sampled at 151st Street (Station 2) and Dickey Road (Station 3). Indiana Harbor was sampled at the monitor (Station 6) and the East Chicago and Hammond water intakes (Stations 15 and 16) were sampled for phenols and cyanides. The following tables are the results of this sampling:

R. J. Bowden

Friday, January 20, 1967

Station	Water Temp.°C	Wind Direction	Cyanide mg/l	Phenol ug/l
2	10	south	0.22	135
3	9	"	0.21	183
6	14	"	0.29	216
15	0	"	0.01	3
16	0	"	none found	2

Saturday, January 21, 1967

2	10	"	0.15	161
3	10	"	0.20	192
6	9	"	0.32	138
15	1	"	none found	2
16	1	southwest	0.02	29

Sunday, January 22, 1967

2	11	calm	0.23	135
3	11	south	0.12	60
6	9	"	0.34	185
15	1	"	none found	1
16	1	"	0.02	16

R. J. Bowden

It is evident that wind induced currents directed the pollution away from the East Chicago intake toward the Hammond intake. The Saturday and Sunday phenols at the Hammond intake were far higher than we had found during almost six months of sampling on week days.

Phenols at 151st Street and Dickey Road were high but not higher than weekly values during the winter months. The phenols at the monitor in Indiana Harbor were higher than normal.

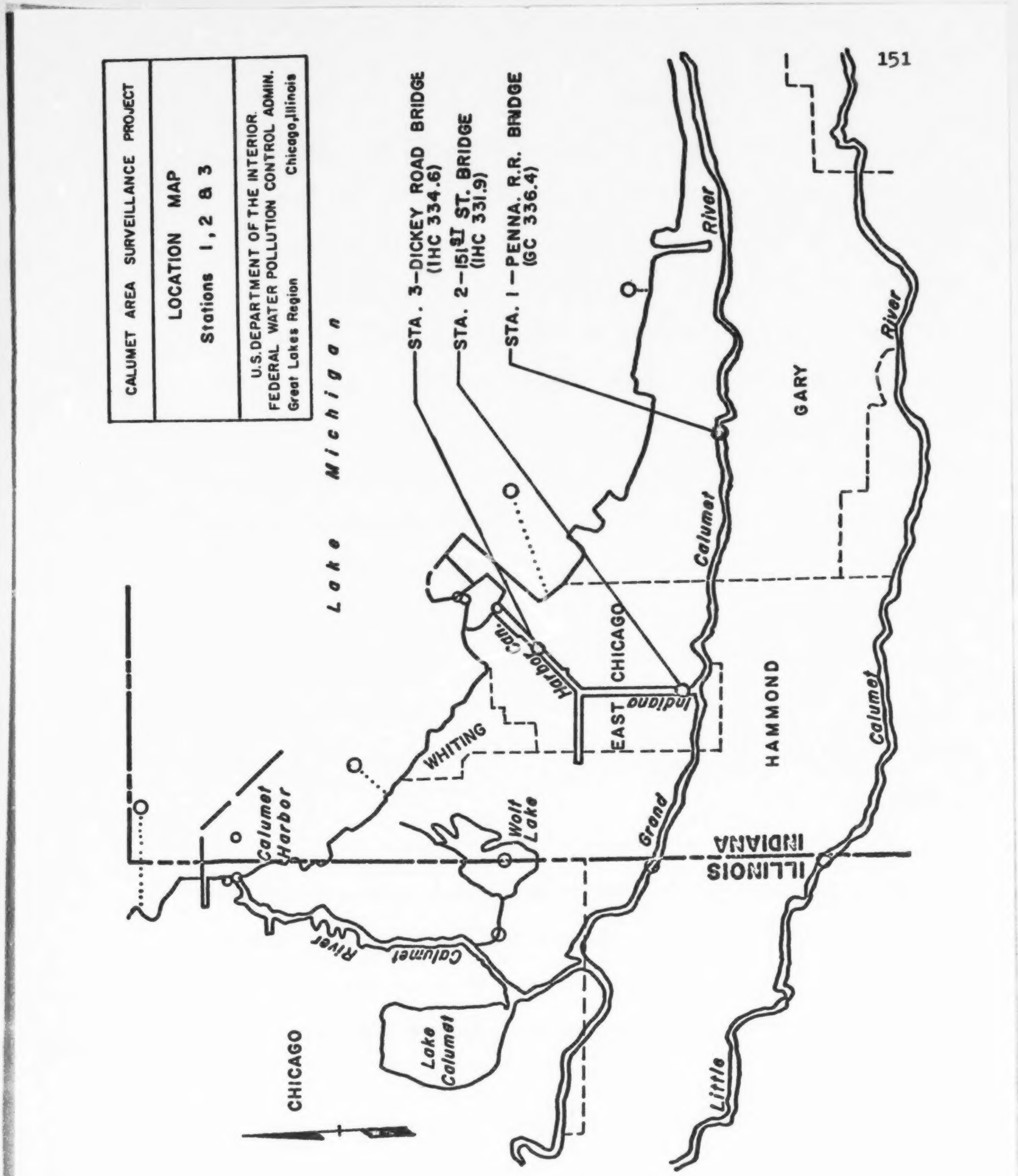
Cyanides were not higher than the weekly samples but were considerably above tolerable limits.

In addition to these data a very large amount of floating oil was observed at all stations on Sunday.

These data indicate that large amounts of phenol were discharged into Indiana Harbor or the Indiana Harbor Canal below Dickey Road during Friday or early on Saturday morning. This fact, and the reported weekend problems with taste and odors, strongly suggest that the Inland Steel Company or the Youngstown Sheet and Tube Company, or both, are the source or sources.

WATER QUALITY

Stream, Harbor and Water Intake Sampling


CALUMET AREA SURVEILLANCE PROJECT
LOCATION MAP
Stations 1, 2 & 3
U.S. DEPARTMENT OF THE INTERIOR.
FEDERAL WATER POLLUTION CONTROL ADMIN.
Great Lakes Region
Chicago, Illinois
STA. 3—DICKEY ROAD BRIDGE (IHC 334.6)
STA. 2—151ST ST. BRIDGE (IHC 331.9)
STA. 1—PENNA. R.R. BRIDGE (GC 336.4)
Lake Michigan
Calumet Harbor
Calumet River
Lake Calumet
Wolf Lake
WHITING
Indiana Harbor Can.
EAST CHICAGO
HAMMOND
GARY
Grand Calumet River
Little Calumet River
CHICAGO
ILLINOIS
INDIANA

Thirteen stream and harbor stations were sampled for bacteriological and chemical quality during the last six months of 1966. Four water intakes located in Lake Michigan and designated as control points by the technical committee, have been sampled since August 3, 1966. Samples were collected once each week except that stations requiring a boat could not be sampled during severe weather. All stream stations were sampled at mid-stream except for the monitor stations, Nos. 6 and 11, which were sampled at the water quality monitor intake. The samples for bacteriological analysis were taken at a depth of 6 inches to 1 foot. The samples for chemical analysis were taken at mid-depth or 10 feet in the case of navigable channels. All water intake samples were taken from the raw water tap at the filtration plant.

All samples were immediately preserved and/or iced where required in accordance with procedures established in "Standard Methods for Examination of Water and Wastewater, 12th Edition, 1965." Laboratory analysis on samples subject to deterioration was initiated on the same day they were collected.

Bacteriological analyses were performed in accordance with "Standard Methods." Total coliform, fecal coliform and fecal streptococci counts were made on each sample. The results of these analyses are presented in bar graphs for each station. All values on these bar graphs and in the following discussion are the number of organisms per 100 ml.

Chemical analyses were performed in accordance with methods agreed upon at the Calumet Area Enforcement Laboratory Directors' Meeting held on April 29, 1965.

Station 1 - Grand Calumet River at Pennsylvania R. R. Bridge

This station is located upstream of the Gary Sewage Treatment Plant where the bulk of the flow is from the United States Steel Company's complex at Gary, Indiana, located approximately two miles upstream.

The data (Table 1) indicate that the trends reported in the January to June 1966 report have continued. Progress has been made toward abating the domestic pollution problem but the industrial waste problem is becoming more severe.

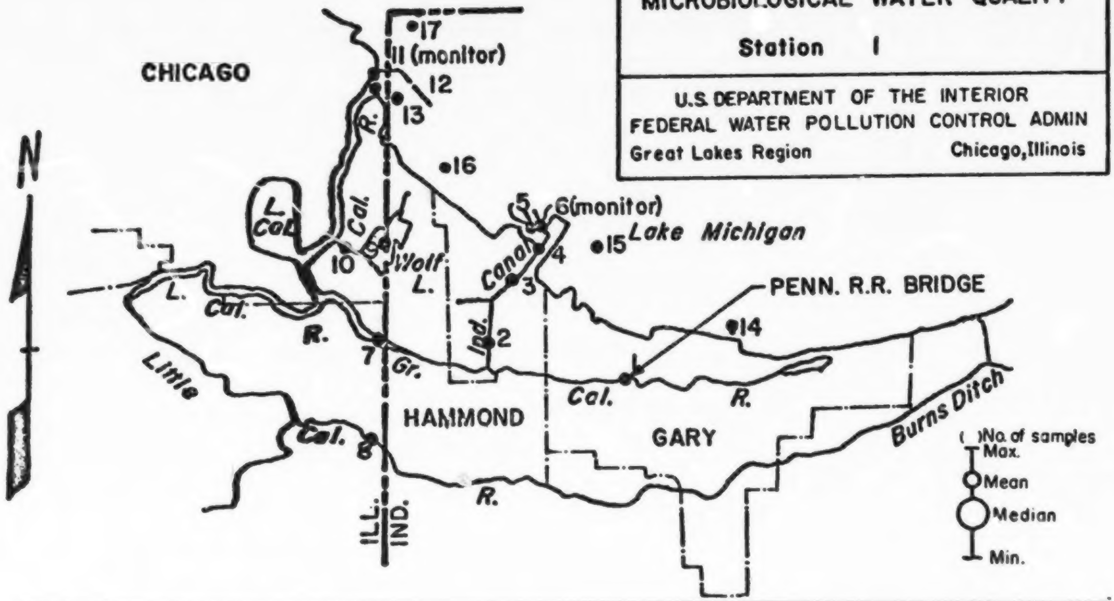
The Microbiological Water Quality graphs on Page 14 indicate that the average and median coliforms were higher during the last half of 1966 than during the first half, probably because the average water temperature was

CALUMET AREA SURVEILLANCE PROJECT

MICROBIOLOGICAL WATER QUALITY

Station I

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN
Great Lakes Region Chicago, Illinois



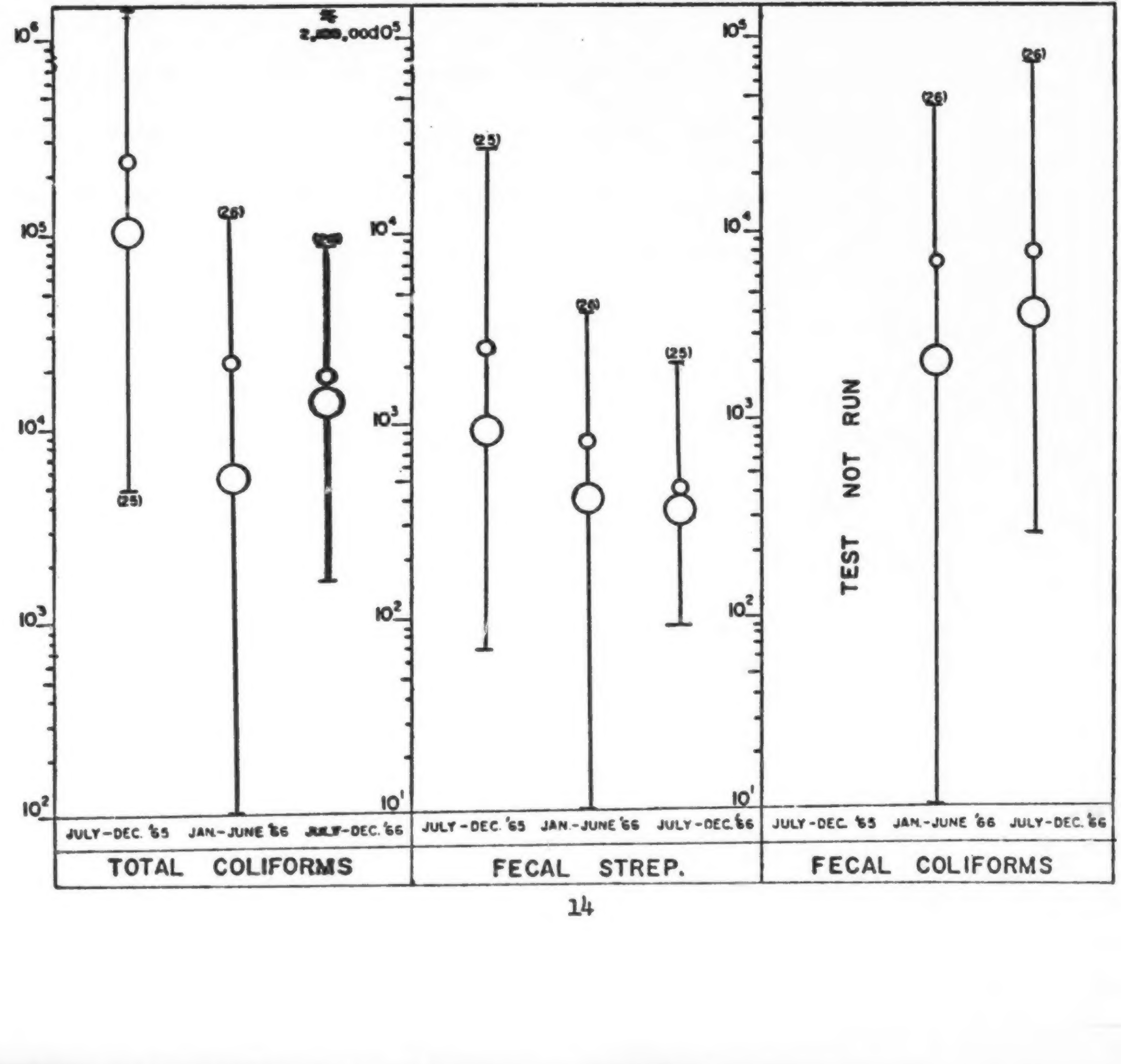


TABLE 1

CHEMICAL QUALITY OF WATER
STATION 1 - GRAND CALUMET RIVER AT PENNSYLVANIA R.R. BRIDGE-GC 336.6

Parameter		July 1965-Dec. 1965 Max	Min	Mean	Median	Jan. 1966-June 1966 Max	Min	Mean	Median	July 1966-Dec. 1966 Max	Min	Mean	Median
Water Temp.	°C	29	12	21.8	21	28	10	16	16	32	10	22.4	24
pH		7.5	4.1	-	6.9	8.0	3.6	-	6.9	7.1	6.5	-	6.8
Conductivity	umho/cm	-	-	-	-	765	308	399	380	580	345	392	375
Alkalinity	mg/1	-	-	-	-	-	-	-	-	122	80	100	101
DO	"	8.7	1.1	4.6	4.3	9.00	2.50	5.83	5.80	8.85	2.10	4.83	4.80
BOD	"	17.0	5.7	9.98	8.4	16	2.4	8.6	8.6	15	3.0	8.03	7.9
COD	"	152	7.9	42.2	31	43	21	28	27	55	14	33	33
Sulphates	"	186	32	60	52	200	37	66	56	71	39	53.8	54
Chlorides	"	-	-	-	-	40	14	20	18	27	10	14.8	17
MBAS	"	-	-	-	-	0.28	0.07	0.14	0.12	.22	.08	.136	.13
NH_3-N	"	3.70	0.87	1.53	1.45	4.4	1.5	2.4	2.4	4.20	.88	2.08	1.7
NO_2+NO_3-N	"	3.65	0.32	0.897	0.68	11.3	0.18	0.89	0.55	0.90	0.09	0.52	0.55
Org. N	"	3.71	0.06	1.48	0.65	1.2	0.0	0.40	0.40	1.1	0.1	0.5	0.4
Sol PO_4	"	0.33	0.00	0.10	0.08	0.41	0.02	0.19	0.17	0.40	0.01	0.05	0.03
Total PO_4	"	1.2	0.10	0.36	0.29	0.58	0.11	0.26	0.23	0.86	0.13	0.32	0.27
Iron	"	29.0	2.2	8.78	6.15	48	3.2	9.7	5.8	40	2.6	16.5	14
Cyanide	"	0.80	0.00	0.12	0.02	0.63	0.00	0.32	0.39	0.58	0.01	0.22	0.20
Sus. Solids	"	130	26	46.55	42	125	30	67	68	195	29	74	62
Dis. Solids	"	364	170	225.77	225	380	205	247	235	294	109	226	230
Phenol	ug/1	392	10.0	79.14	30.0	320	18	126	129	254	7.6	53.2	43
		Data based on 19 samples				Data based on 26 samples				Data based on 26 samples			

16°C during the first six months and 22.4°C during the last six months. This was also true for all of the other stations.

Median and average total coliform and fecal streptococci counts from July-December 1966 were approximately one-tenth of their levels during the same period in 1965. This, combined with the fact that the water temperatures were slightly higher in 1966, indicates that the improvement noted in our previous report has been continued.

On July 28, 1966, there was one very high total coliform count of 2,100,000 per 100 ml. The maximum fecal coliform count also occurred on that date. The high counts must have resulted from an accidental spill or overflow to the stream because they do not represent the general quality of the stream.

Although an improvement has been made, the microbiological pollution of the stream is still too great to meet any reasonable criteria that may be established for the stream.

Data in Table 1 "Chemical Quality of Water" clearly indicate the increased levels of industrial waste pollution. The rise in water temperature since 1965 is attributable to the use of more cooling water. Other water quality indices affected by wastes from steel mills show considerable increases. Total iron increased from an average of 8.78 mg/l in 1965 to 16.5 mg/l in 1966. Cyanides rose from 0.12 mg/l to 0.22 mg/l and the median phenol value rose from 30.0 ug/l to 43 ug/l. It should be noted in the July-December 1965 data the mean phenol value was affected by one unusually high value. Suspended and dissolved solids also increased. Oil has been reported on the surface at every sampling.

Sulphates, which is an indicator of spent pickle liquor, did not increase. This may be the result of the deep well injection system that has been built by the steel companies for the disposal of this waste. No large slugs of spent pickling liquor such as the one reported on June 3, 1966, were detected during the last half of 1966.

Station 2 - Indiana Harbor Canal at 151st St.

This station was established in order to determine the quality of the water in the canal where it is formed by the two portions of the Grand Calumet River. The stream at this point is affected by effluent from the Gary, Hammond and East Chicago sewage treatment plants as well as effluents from a number of industries on the Grand Calumet River. The

Gary and East Chicago sewage treatment plants are chlorinating their effluent at present.

The trends noted in the report on January-June 1966, and at Station 1, continue to be evident at this station. A comparison of the microbiological bar graphs for Stations 1 and 2 shows that the patterns are the same but the level of pollution is higher. Once again the increase over the first half of 1966 is attributed to the temperature differential and a considerable improvement in quality over January-June 1965 is evident. The higher level of microbiological pollution is due to the sewage treatment plants that affect Station 2.

The pattern of increasing industrial pollution is also the same with one exception. Cyanides originating upstream of Station 1 would be expected to degrade considerably before reaching Station 2. This was not the case in 1965. It is likely that there was a source of cyanide between the two stations. In 1966, however, the cyanides at Station 2 were considerably lower than at Station 1, which may indicate that cyanide from that source has been abated.

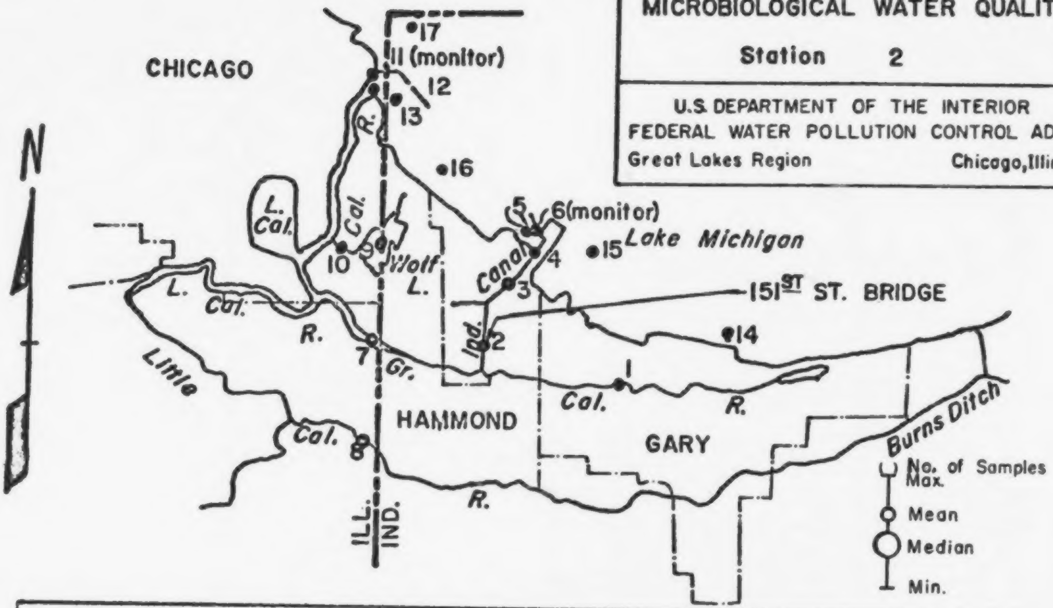
Samples from this station were composited on a monthly basis and analyzed for heavy metals. The following are average values for the last six months of 1966:

CALUMET AREA SURVEILLANCE PROJECT

MICROBIOLOGICAL WATER QUALITY

Station 2

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN
Great Lakes Region Chicago, Illinois



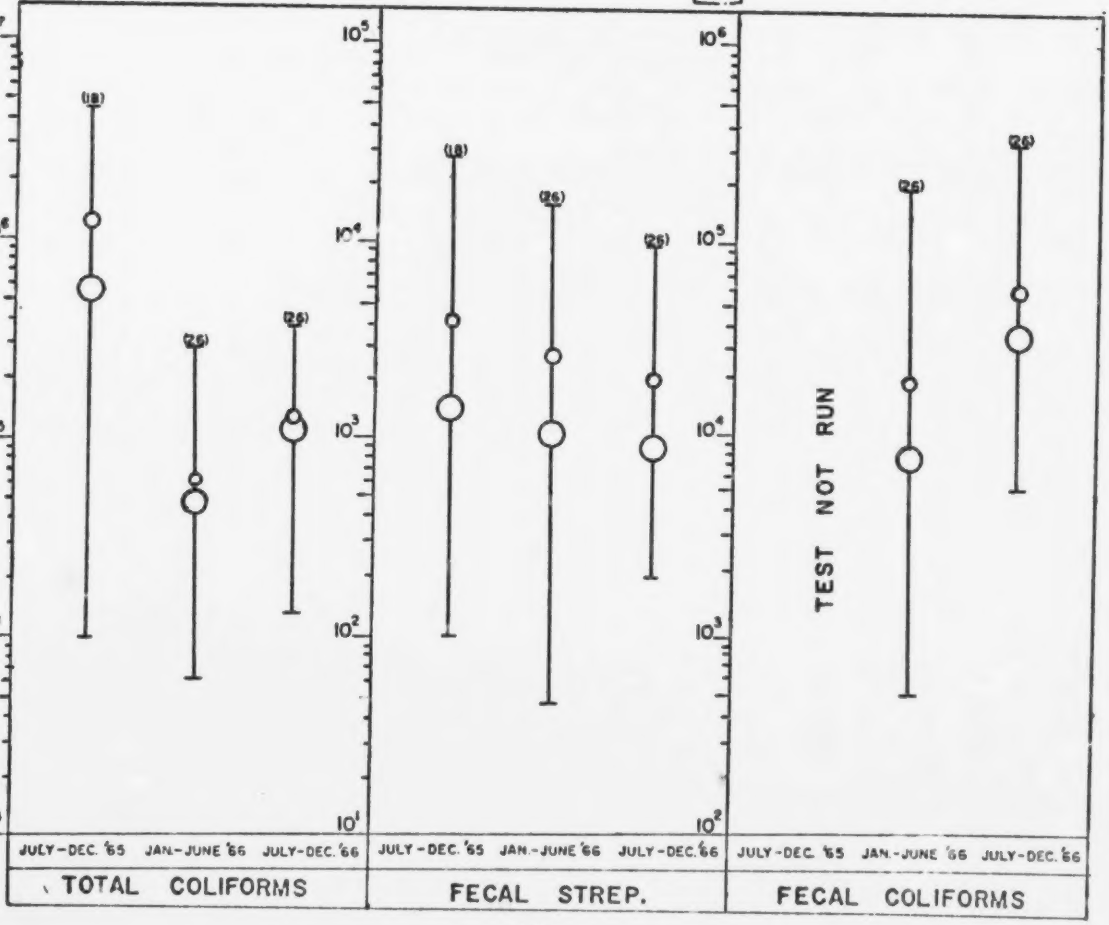


TABLE 2

CHEMICAL QUALITY OF WATER
STATION 2 - INDIANA HARBOR CANAL - 151ST ST.-IHC 331.9

		July 1965-Dec. 1965				Jan. 1966-June 1966				July 1966-Dec. 1966			
Parameter		Max	Min	Mean	Median	Max	Min	Mean	Median	Max	Min	Mean	Median
Water Temp.	°C	27	11	18.3	18.5	26	5	15	15	31	10	22.0	22.0
pH		7.3	6.3	-	7.0	7.9	6.5	-	7.0	7.2	6.3	-	6.9
Conductivity	umho/cm	-	-	-	-	530	430	473	480	550	385	456	450
Alkalinity	mg/l	-	-	-	-	-	-	-	-	156	84	111.7	105
DO	"	7.7	2.1	4.4	4.6	8.1	0.20	5.07	5.60	7.15	0.85	3.69	3.65
BOD	"	13.0	4.4	9.0	11.0	22	4.9	8.9	7.6	14	5.2	8.94	8.7
COD	"	148	7.7	41.7	39.5	60	18	29	28	59	17	34.6	33
Sulphates	"	128	50	70	66	138	74	88	87	99	50	72.8	73
Chlorides	"	-	-	-	-	70	29	36	32	40	16	25	25
MBAS	"	-	-	-	-	0.61	0.16	0.29	0.29	0.30	0.13	0.21	0.22
NH_3-N	"	4.0	0.77	2.45	2.8	4.7	2.4	3.4	3.3	5.1	1.6	3.6	3.1
NO_2+NO_3-N	"	2.20	0.23	1.13	1.10	1.5	0.21	0.80	0.80	1.70	0.08	0.73	0.65
Org. N	"	4.30	0.30	1.17	0.90	1.3	0.00	0.6	0.7	5.0	0.1	0.87	0.6
Sol PO_4	"	0.84	0.11	0.49	0.46	1.32	0.19	0.58	0.50	0.81	0.10	0.42	0.40
Total PO_4	"	4.60	0.52	1.26	1.15	2.0	0.32	0.82	0.75	2.8	0.56	1.44	1.3
Iron	"	15.0	0.78	4.55	1.50	17	1.8	5.5	4.4	29	2.8	12.3	12
Cyanide	"	0.53	0.00	0.11	0.20	0.44	0.00	0.19	0.16	0.20	0.04	0.10	0.09
Sus. Solids	"	136	10	41.3	34	110	23	61	59	162	7	60.8	55
Dis. Solids	"	640	240	297	270	375	250	295	295	300	160	256.8	260
Phenol	ug/l	308.0	9.0	71.2	25	228	23	107	111	263	15	47.0	32
		Data based on 15 samples				Data based on 26 samples				Data based on 26 samples			

Cadmium	less than 0.005	mg/l
Copper	0.07	"
Chromium	0.07	"
Potassium	4.6	"
Manganese	0.27	"
Lead	0.14	"
Nickel	0.03	"
Arsenic	less than 0.001	"
Zinc	1.17	"
Sodium	18	

Station 3 - Indiana Harbor Canal at Dickey Road

This station is located two and a half miles downstream from 151st St. (Station 2) and is the last highway bridge across the canal before it discharges into Indiana Harbor.

The trends in water quality noted at the two upstream stations also occurred at this station. The bacterial counts were lower in 1966, the dissolved oxygen higher and industrial pollution more evident.

The decline in sewage pollution reported in the January-June 1966 report is confirmed by the July-December data. DO increased despite the fact that the median

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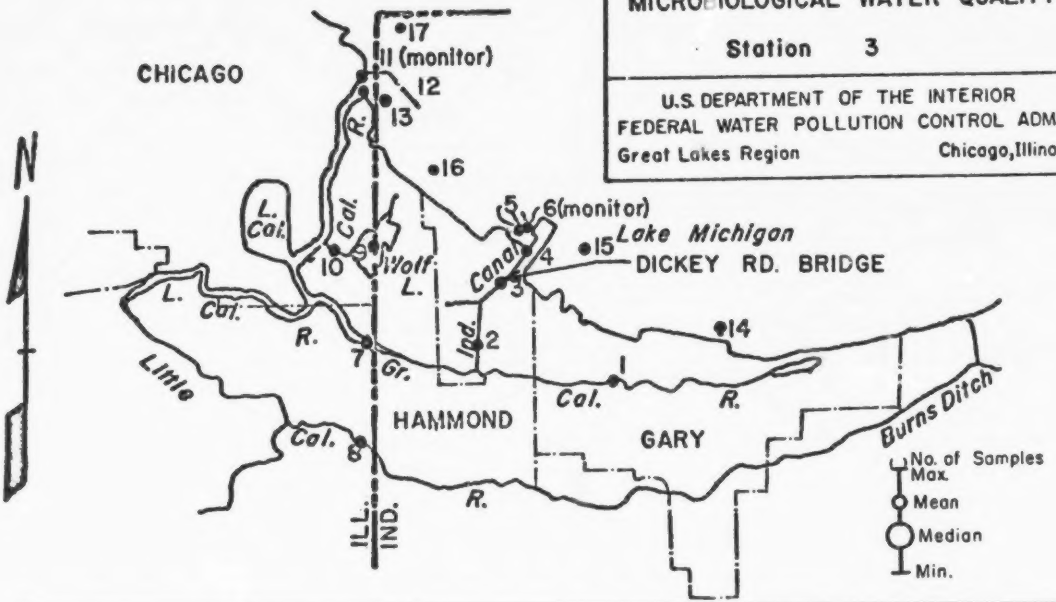
CALUMET AREA SURVEILLANCE PROJECT

MICROBIOLOGICAL WATER QUALITY

Station 3

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN
Great Lakes Region Chicago, Illinois



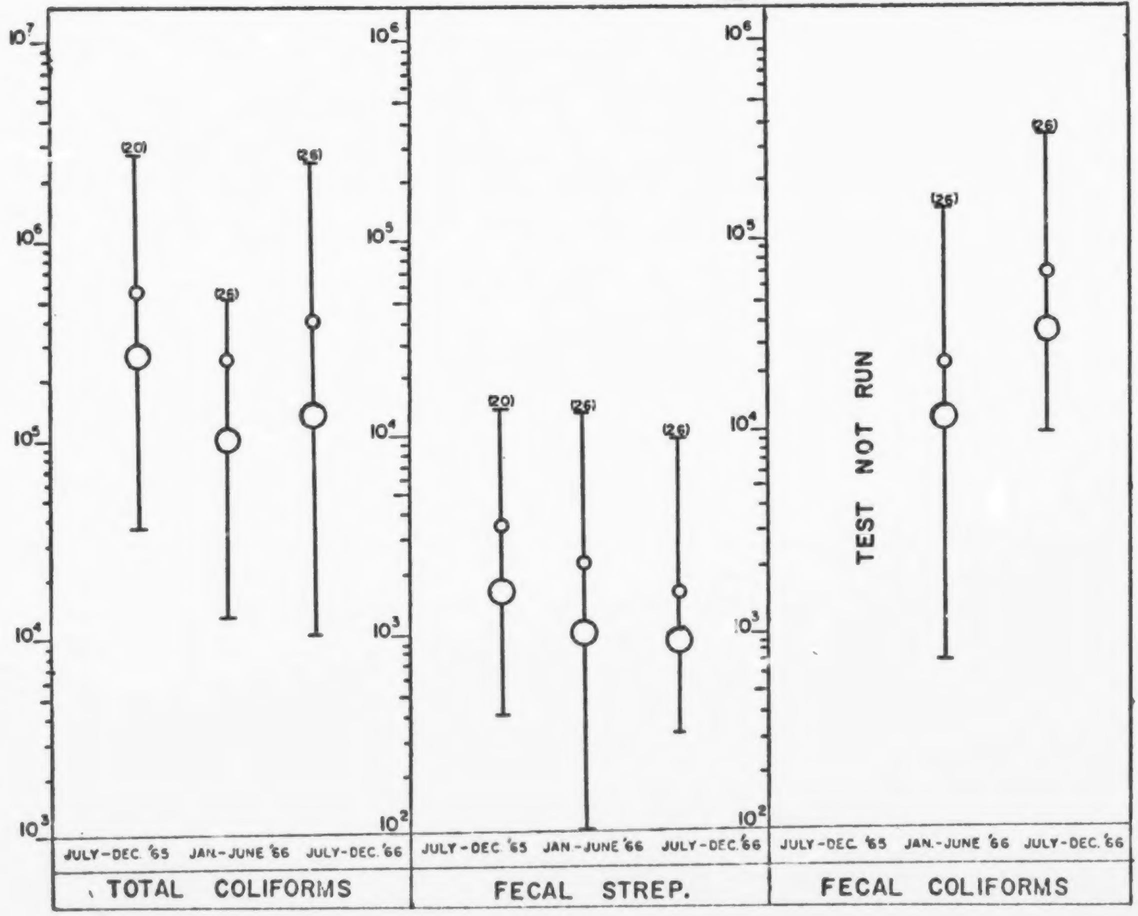


TABLE 3

CHEMICAL QUALITY OF WATER
STATION 3 - INDIANA HARBOR CANAL AT DICKEY ROAD-IHC 334.6

Parameter		July 1965-Dec. 1965				Jan. 1966-June 1966				July 1966-Dec. 1966			
		Max	Min	Mean	Median	Max	Min	Mean	Median	Max	Min	Mean	Median
Water Temp.	°C	29	11	20	21.5	27	9	15	14	31	8	21.1	25
pH		7.3	6.3	-	7.0	8.0	6.4	-	7.0	7.1	6.7	--	6.9
Conductivity	umho/cm	-	-	-	-	615	400	501	505	800	410	495	470
Alkalinity	mg/1	-	-	-	-	-	-	-	-	122	65	104	111
DO	"	6.40	0.00	1.82	0.25	6.70	0.00	3.10	4.10	7.20	0.00	2.04	1.55
BOD	"	11.0	3.5	6.25	5.7	9.0	2.2	5.1	5.3	18	2.5	5.9	5.0
COD	"	147.00	0.00	33.95	27.3	33	12	22	22	47	15	24.6	24
Sulphates	"	96.00	45.60	70.64	74	122	59	80	78	100	61	75	81
Chlorides	"	-	-	-	-	44	22	29	29	47	22	30.6	30
MBAS	"	-	-	-	-	0.35	0.17	0.24	0.24	0.55	0.17	0.34	0.30
NH_3-N	"	3.40	1.10	2.48	2.65	6.7	2.6	3.7	3.6	5.8	1.5	3.4	3.2
NO_2+NO_3-N	"	3.50	0.31	1.15	1.05	2.8	0.15	0.84	0.75	2.40	0.20	0.71	0.65
Org. N	"	5.40	0.08	1.68	1.05	2.4	0.3	0.7	0.6	4.5	0.2	0.9	0.7
Sol PO_4	"	0.86	0.04	0.29	0.285	0.54	0.11	0.32	0.29	0.50	0.08	0.22	0.22
Total PO_4	"	1.10	0.24	0.59	0.55	0.73	0.26	0.47	0.46	1.3	0.05	.75	0.73
Iron	"	4.90	0.88	2.35	2.05	9.0	0.99	3.16	2.3	7.7	1.6	3.1	2.9
Cyanide	"	0.29	0.00	0.03	0.00	0.56	0.00	0.13	0.13	0.27	0.01	0.07	0.04
Sus. Solids	"	41.0	6.5	15.94	15.0	84	6	25	19	64	4	23	21
Dis. Solids	"	360.0	240.0	291.4	290	385	220	314	310	336	141	272.7	280
Phenol	ug/1	232.0	1.2	39.0	20.0	483	16	102	61	235	10	35	24
		Data based on 26 samples				Data based on 26 samples				Data based on 26 samples			

temperature increased from 21.5°C to 25° C. The graph "Microbiological Water Quality-Station 3" on Page 162 reveals lower coliform counts in 1966 but this reduction is not as sharp as the reduction at the two upstream stations.

Although some improvement has been made, DO was often zero during July, August and September 1966, and gassing was noted on several occasions.

The industrial waste parameters follow the pattern established at the upstream stations; significantly higher total iron, cyanide, suspended solids and phenols. The sulphates also increased from a median of 74 in July-December 1965 to a median of 81 in July-December 1966.

Samples for this station were composited on a monthly basis and analyzed for heavy metals. The following are average values for the last six months of 1966:

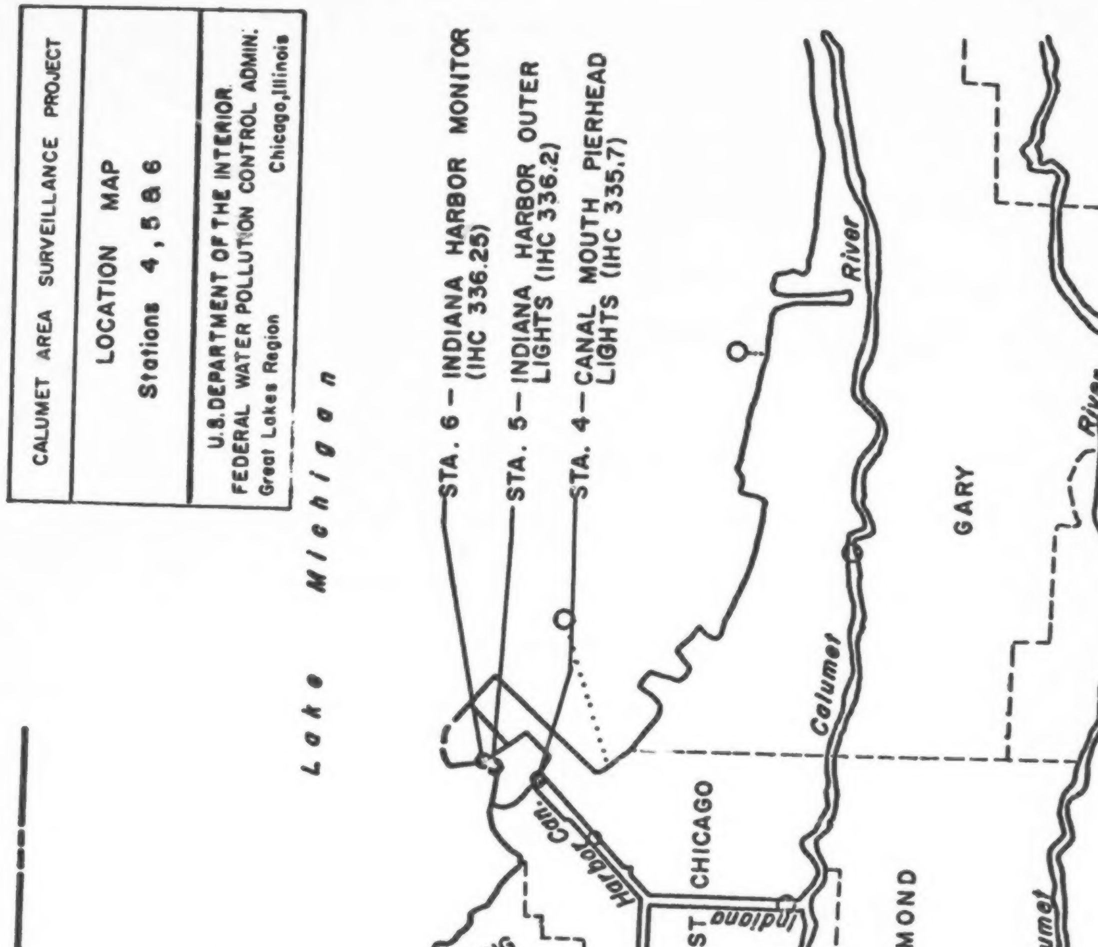
Cadmium	less than	0.005	mg/l
Copper		0.08	"
Chromium		0.04	"
Potassium		4.5	"
Manganese		0.22	"
Lead		0.06	"
Nickel		0.03	"
Arsenic	less than	0.001	"

Zinc	0.63	"
Sodium	21	

Stations 4, 5 and 6 - Indiana Harbor

Indiana Harbor was sampled at three points during 1966. Station 4 is located at the mouth of the Indiana Harbor Canal, upstream of the Inland Steel and Youngstown Sheet and Tube turning basins. Station 5 is located immediately downstream of the turning basins and downstream from all industrial outfalls to the harbor. The average dry weather flow to Lake Michigan past this station is 2700 cfs, but under certain wind and lake level conditions lake water is backed up into the harbor for short periods of time. Station 6 is located at the east breakwall inner light which is about 150 feet from Station 5 and contains a water quality monitoring station. Station 6 was established to correlate the monitoring program with the sampling program.

Stations 4 and 5 are boat stations and cannot be sampled in rough weather. During 1966 they were sampled between March 31, 1966, and October 27, 1966. Therefore, the data at these stations is less affected by the colder months.


CALUMET AREA SURVEILLANCE PROJECT
LOCATION MAP
Stations 4, 5 & 6
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN.
Great Lakes Region
Chicago, Illinois
STA. 6 — INDIANA HARBOR MONITOR (IHC 336.25)
STA. 5 — INDIANA HARBOR OUTER LIGHTS (IHC 336.2)
STA. 4 — CANAL MOUTH PIERHEAD LIGHTS (IHC 335.7)
Lake Michigan
CHICAGO
Lake Calumet
Calumet River
Calumet Harbor
Wolf Lake
WHITING
EAST CHICAGO
Harbor Can.
Indiana
HAMMOND
GARY
Grand Calumet River
Little Calumet River
ILLINOIS
INDIANA

The trends observed at the upstream stations were also apparent at these stations. At Station 4, the coliform counts, graphed on Page 25, were higher during the last six months of 1966, probably because of the higher average tempetature. The average temperature during January-June 1966 was 18°C, and 24.5°C during the July-December period. The counts for all three bacterial parameters were lower in the last half of 1966 than in the last half of 1965.

At Stations 5 and 6 the microbiological quality improved since the first half of 1966. The graphs on Pages 26 and 27 show lower counts in spite of the higher water temperatures during the last half of the year. It appears that discharges of sewage directly to Indiana Harbor have been reduced.

Industrial wastes did not follow a like pattern. As they have in all the Grand Calumet River-Indiana Harbor Canal stations, these parameters have shown a steady increase. Tables 4 and 5 show increased concentrations of ammonia nitrogen, total and soluble phosphates, iron, cyanide, suspended solids and phenols. December 1966 values for phenols and cyanide were very high at Station 6. Higher water temperatures in 1966 than in 1965 may be the result of more cooling water being discharged to the streams. This in itself is not serious but the higher temperatures should result in lower phenols, cyanides and ammonia concentrations because high temperature speeds the decomposition of these compounds. The fact that the concentrations went up when they should have gone down indicates increased discharges to the canal and harbor.

Station 7 - Grand Calumet River at Indiana Harbor Belt Railroad Bridge

This station is located in Illinois near the Illinois-Indiana State line and was established to measure the amount of pollution crossing the State line. This is one of the water quality control points established by the Calumet Area Technical Committee.

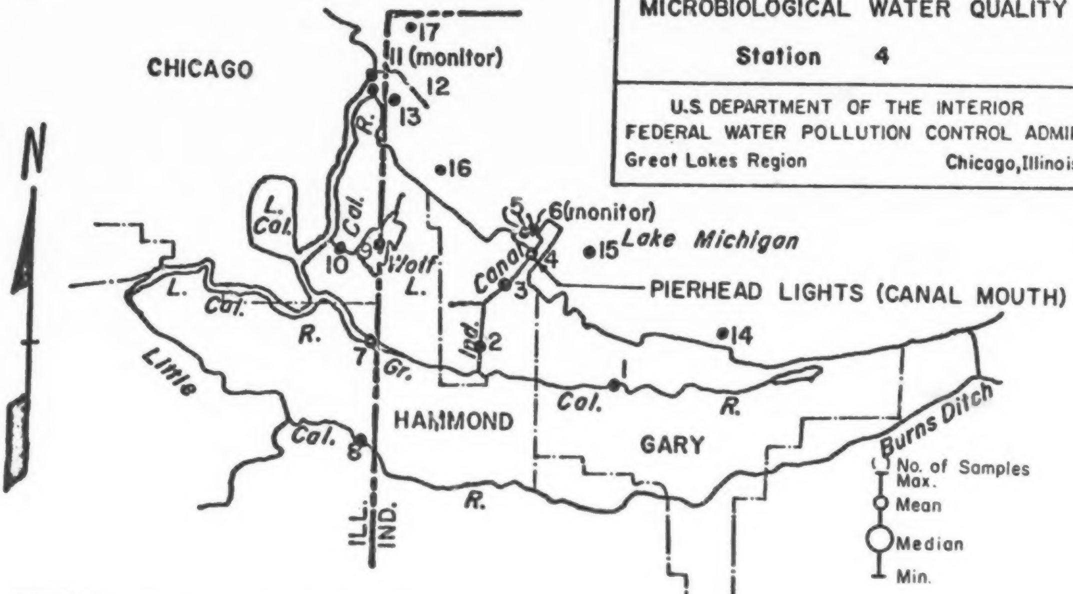
Most of the dry weather flow in this stream is effluent from the Hammond Sewage Treatment Plant and industrial effluent from one steel mill and several smaller industries.

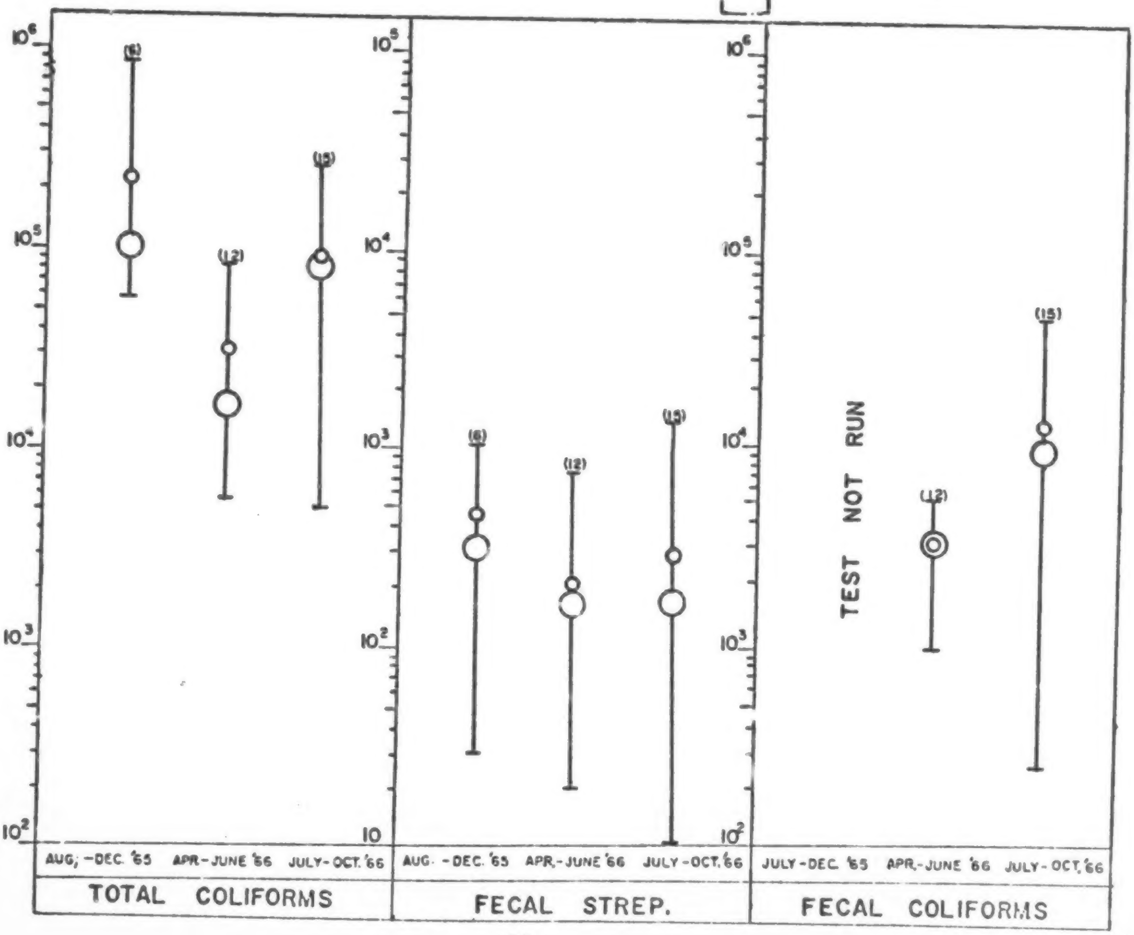
Between July and November 1966 the microbiological quality of the stream was improved. Total coliforms averaged 258,000 per 100 ml. Fecal streptococci averaged 2400 per 100 ml and fecal coliforms averaged 48,000 per

CALUMET AREA SURVEILLANCE PROJECT

MICROBIOLOGICAL WATER QUALITY
Station 4

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN
Great Lakes Region Chicago, Illinois



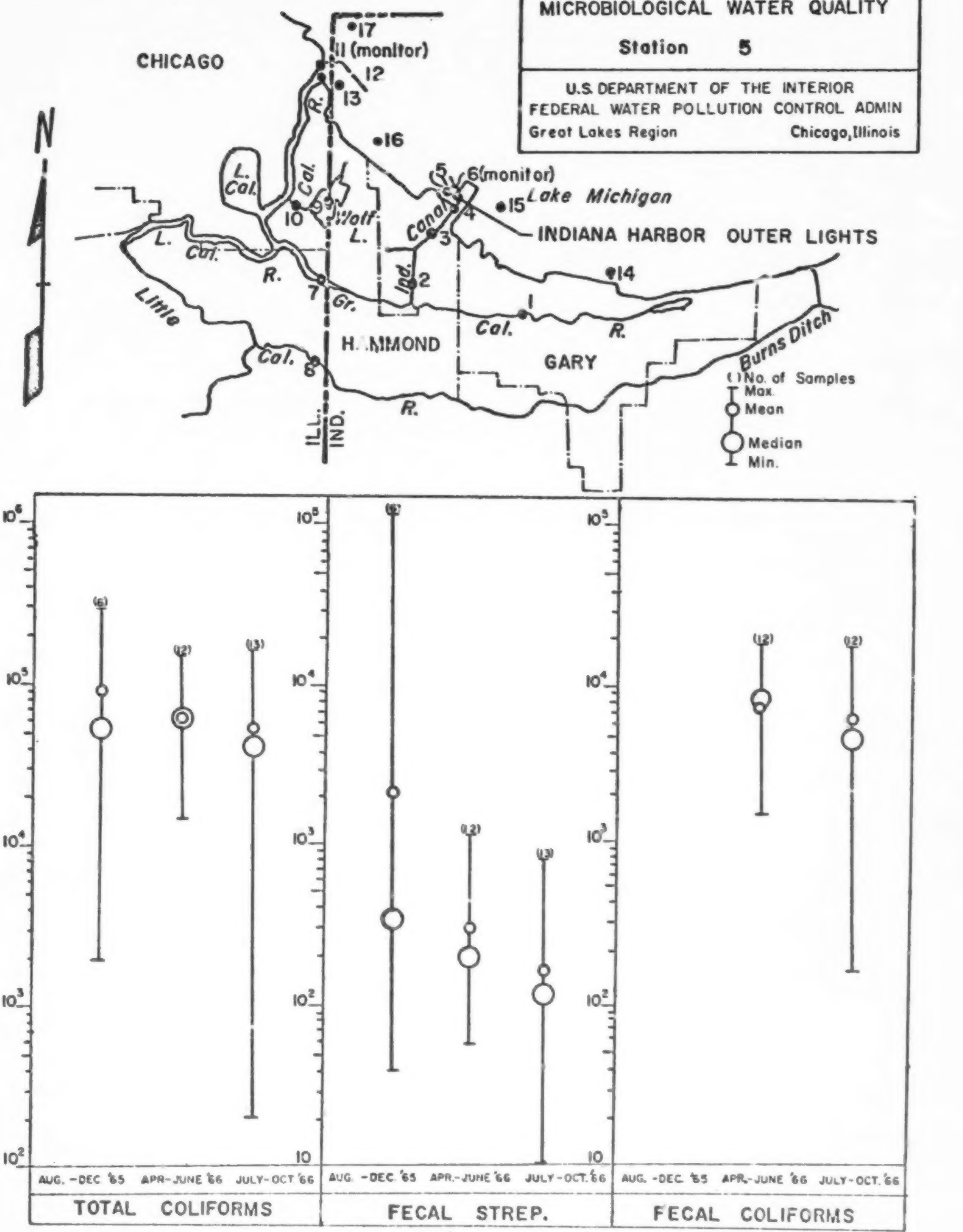


CALUMET AREA SURVEILLANCE PROJECT

MICROBIOLOGICAL WATER QUALITY

Station 5

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN
Great Lakes Region Chicago, Illinois

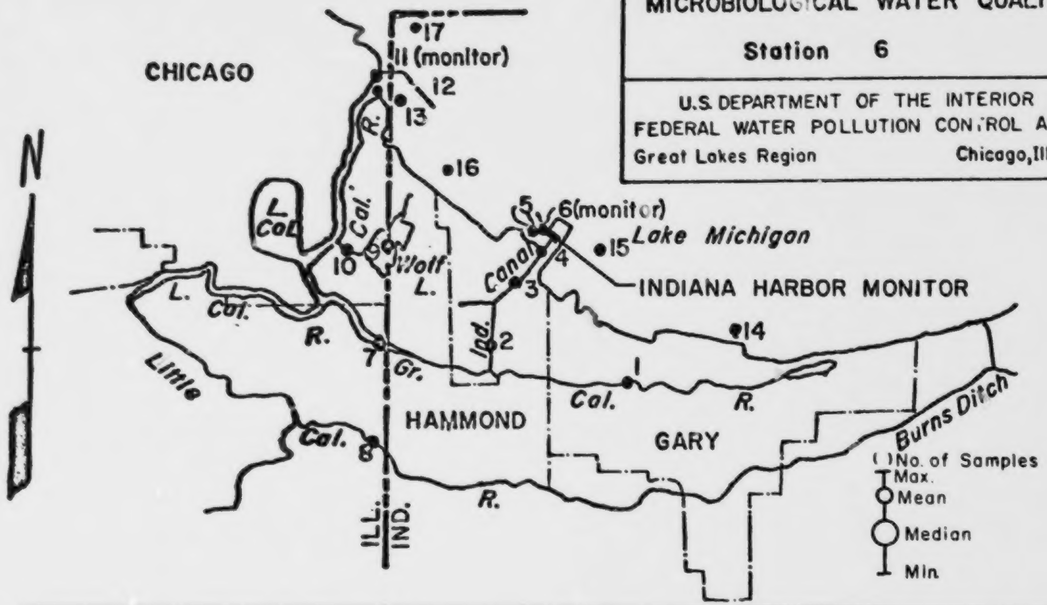


CALUMET AREA SURVEILLANCE PROJECT

MICROBIOLOGICAL WATER QUALITY

Station 6

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN
Great Lakes Region Chicago, Illinois



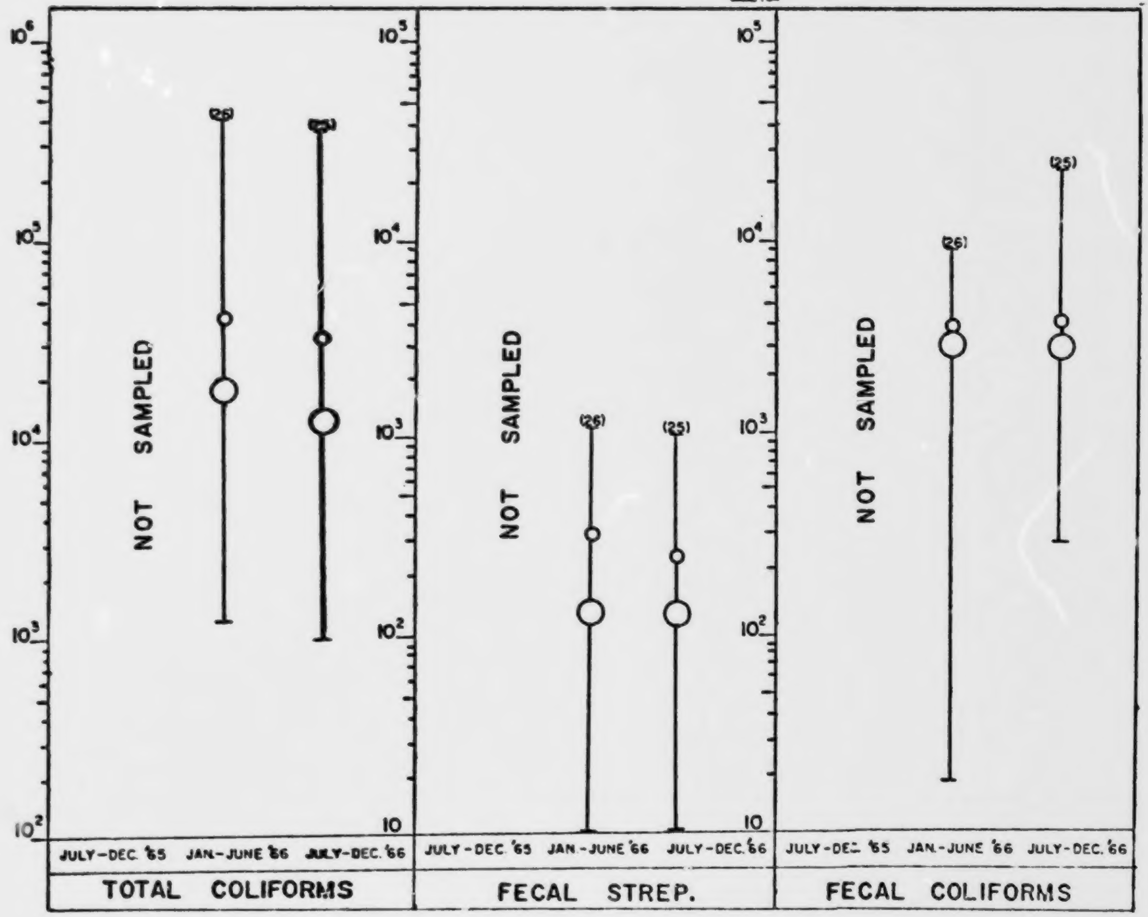


TABLE 4

CHEMICAL QUALITY OF WATER
STATION 4 - INDIANA HARBOR CANAL AT PIERHEAD LIGHTS-IHC 335.7

Parameter		Aug. 1965-Dec. 1965				Apr. 1966-June 1966				July 1966-Oct. 1966			
		Max	Min	Mean	Median	Max	Min	Mean	Median	Max	Min	Mean	Median
Water Temp.	°C	26	11	20.8	23	24	12	18	19	29	15	24.5	26
pH		7.3	6.8	-	7.1	8.0	6.8	-	7.0	7.4	6.8	-	7.1
Conductivity	umho/cm	-	-	-	-	460	385	419	420	430	301	370	370
Alkalinity	mg/1	-	-	-	-	-	-	-	-	109	51	90.5	98.0
DO	"	6.6	2.36	3.81	3.50	5.2	2.05	3.74	3.60	7.20	0.90	3.43	3.15
BOD	"	9.1	2.8	4.7	3.9	5.0	2.4	3.8	4.1	7.0	2.8	4.06	3.7
COD	"	126	0	37.5	9.3	18	11	13	15	58	6	19.9	16
Sulphates	"	62	34	52	55	84	23	65	70	75	36	52.8	50
Chlorides	"	-	-	-	-	30	21	25	25	23	10	19.9	22
MBAS	"	-	-	-	-	0.25	0.07	0.17	0.17	0.25	0.10	0.176	0.18
NH3-N	"	1.90	0.75	1.21	1.14	5.6	2.2	3.2	3.0	3.8	0.8	2.17	2.1
NO_2+NO_3-N	"	0.74	0.29	0.42	0.38	0.55	0.11	0.31	0.30	0.80	0.17	0.43	0.39
Org. N	"	1.74	0.30	0.94	0.50	0.9	0.0	0.4	0.4	1.4	0.2	0.53	0.5
Sol PO_4	"	0.10	0.03	0.06	0.06	0.19	0.06	0.14	0.15	0.11	0.04	0.07	0.07
Total PO_4	"	0.29	0.08	0.18	0.17	0.27	0.09	0.18	0.20	0.45	0.19	0.27	0.23
Iron	"	5.00	2.00	2.92	2.55	4.9	1.5	3.0	3.0	44	1.2	5.49	2.5
Cyanide	"	0.01	0.00	0.001	0.00	0.25	0.00	0.07	0.07	0.09	0.02	0.04	0.03
Sus. Solids	"	107	11	30.8	13	81	11	21	16	37	7	16.9	15
Dis. Solids	"	253	215	238	235	305	230	263	265	268	130	207	210
Phenol	ug/1	42	5.55	16.4	13	26	11	18	18	84	5	18	9
Turbidity	units	-	-	-	-	-	-	-	-	3.4	2.5	-	-
		Data based on 7 samples				Data based on 12 samples				Data based on 15 samples			

TABLE 5

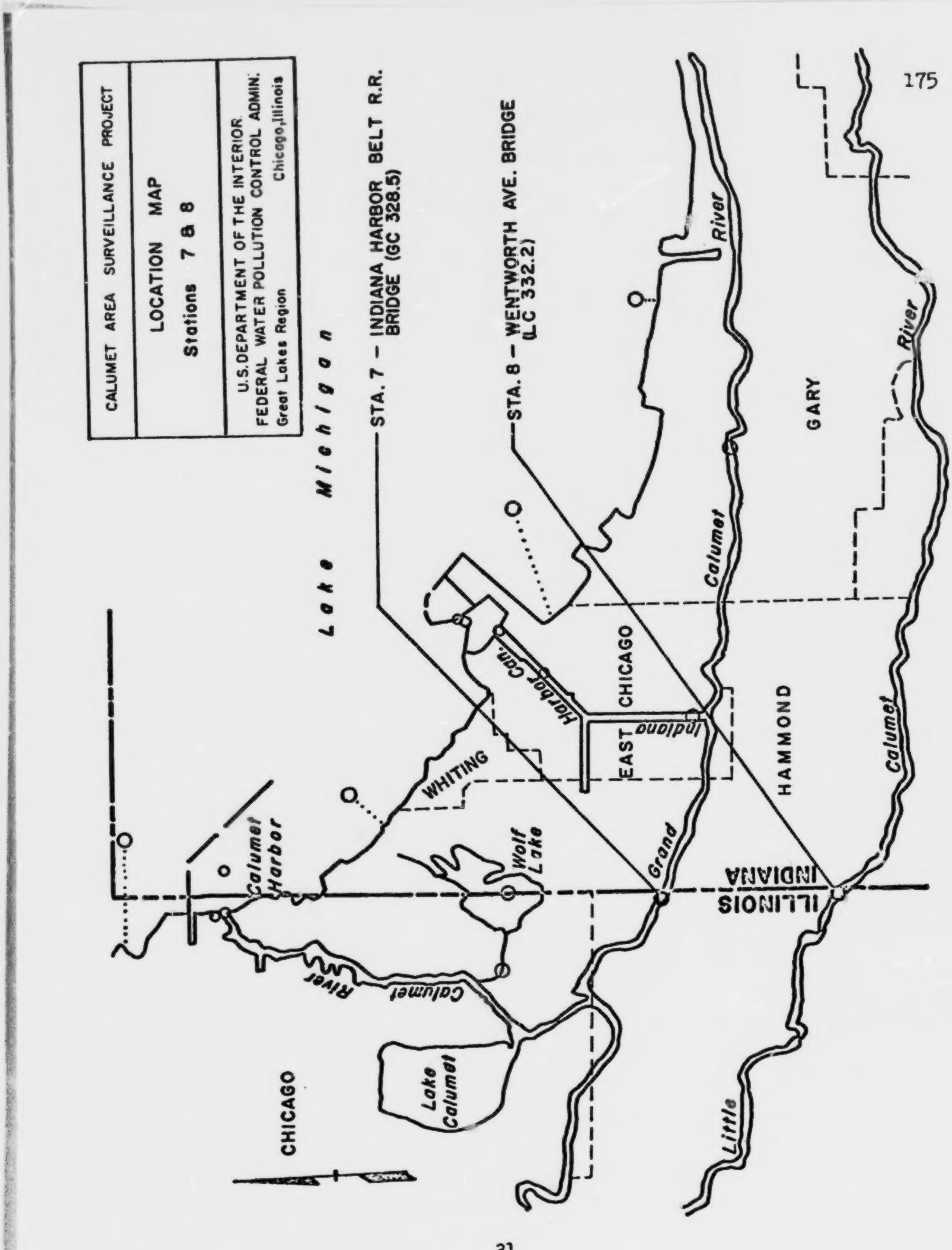
CHEMICAL QUALITY OF WATER
STATION 5 - INDIANA HARBOR AT INNER BREAKWALL LIGHTS-IHC 336.2

		Aug. 1965-Dec. 1965				Apr. 1966-June 1966				July 1966-Oct. 1966			
Parameter		Max	Min	Mean	Median	Max	Min	Mean	Median	Max	Min	Mean	Median
Water Temp.	°C	26.0	10	20.4	21	23	12	17	17	29	17	24.2	26
pH		7.3	6.8	-	7.1	7.9	6.8	-	7.0	7.3	6.6	-	7.0
Conductivity	umho/cm	-	-	-	-	420	350	384	385	400	330	364	365
Alkalinity	mg/1	-	-	-	-	-	-	-	-	94	72	87	89
DO	"	6.8	1.85	4.58	5.45	6.65	3.05	4.63	4.80	6.00	0.85	3.17	3.10
BOD	"	13.0	2.3	4.4	3.0	5.5	2.0	3.3	3.5	4.4	2.2	3.0	2.9
COD	"	121.0	8.4	37.0	8.6	27	8	13.3	13	28	6	15.2	13
Sulphates	"	56	32	47	50	81	45	62	62	76	41	50.5	48
Chlorides	"	-	-	-	-	26	16	22	23	25	16	21.4	21
MBAS	"	-	-	-	-	0.21	0.10	0.14	0.14	0.21	0.09	0.15	0.14
NH_3-N	"	1.90	0.38	1.04	0.88	4.4	1.5	2.4	2.4	2.9	1.2	1.88	1.8
NO_2+NO_3-N	"	0.59	0.26	0.42	0.44	0.45	0.12	0.29	0.32	5.0	0.14	0.68	0.35
Org. N	"	1.38	0.10	0.69	0.61	0.8	0.00	0.2	0.2	1.5	0.0	0.37	0.3
Sol PO_4	"	0.12	0.03	0.07	0.07	0.11	0.00	0.07	0.08	0.10	0.03	0.055	0.05
Total PO_4	"	0.31	0.06	0.17	0.16	0.19	0.08	0.12	0.14	0.37	0.09	0.18	0.20
Iron	"	2.96	1.25	1.93	1.80	5.6	1.3	3.0	3.1	3.8	1.3	2.37	2.2
Cyanide	"	0.19	0.00	0.03	0.01	0.19	0.01	0.05	0.02	0.14	0.01	0.043	0.03
Sus. Solids	"	13	3.0	7.9	8.0	3.7	9.0	14.8	13	210	1	41	13
Dis. Solids	"	254	230	237	240	280	205	240	235	379	175	228	208
Phenol	ug/1	23	0	6.4	4.9	19	5.4	10.4	10.0	41	3	10.4	7
Turbidity	units	-	-	-	-	11.2	1.8	6.3	6.2	13.0	1.6	5.0	4.2
		Data based on 7 samples				Data based on 12 samples				Data based on 15 samples			

TABLE 6

CHEMICAL QUALITY OF WATER
STATION 6 - INDIANA HARBOR AT EAST BREAKWALL INNER LIGHT
(WATER QUALITY MONITOR STATION)-IHC 336.25

Parameter		July 1965-Dec. 1965				Jan. 1966-June 1966				July 1966-Dec. 1966			
		Max	Min	Mean	Median	Max	Min	Mean	Median	Max	Min	Mean	Median
Water Temp.	oC	NOT SAMPLED IN 1965				19	6	12	12	29	9	19.9	21
pH						8.0	6.6	-	7.0	7.7	6.7	-	7.0
Conductivity	umho/cm					460	320	372	385	470	310	372	360
Alkalinity	mg/l					-	-	-	-	111	79	93	93
DO	"					8.0	2.80	6.50	7.1	8.05	1.15	5.32	5.90
BOD	"					5.6	1.7	3.4	3.6	13.0	1.2	4.09	3.3
COD	"					37	4.0	12.0	11.0	72	5	19.8	15
Sulphates	"					77	34	59	66	70	22	43.6	45
Chlorides	"					32	10	21	22	33	9	20.8	21
MBAS	"					.35	.08	.15	.15	0.30	0.05	0.15	0.14
NH_3-N	"					2.8	0.19	1.9	1.9	2.5	.6	1.5	1.4
NO_2+NO_3-N	"					0.70	0.12	0.42	0.40	.80	.10	.47	.45
Org. N	"					2.1	0.2	0.6	0.5	2.70	.0	.57	.40
Sol PO_4	"					0.30	0.03	0.09	0.08	0.10	0.01	0.05	0.06
Total PO_4	"					0.34	0.08	0.14	0.13	1.40	.08	0.25	0.19
Iron	"					8.1	1.3	3.1	3.0	15.0	1.1	3.72	2.5
Cyanide	"					0.20	0.00	0.08	0.07	0.35	0.00	0.07	0.03
Sus. Solids	"					46	8	17	15	119	.7	26.2	16
Dis. Solids	"					265	200	239	240	266	128	211	215
Phenol	ug/l					45	1.4	15.6	14	422.	2.	27.0	7
Turbidity	units					-	-	-	-	55.0	1.6	17.8	16.5
						Data based on 26 samples				Data based on 25 samples			



CALUMET AREA SURVEILLANCE PROJECT

LOCATION MAP

Stations 7 & 8

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN.
Great Lakes Region Chicago, Illinois

100 ml. The graph "Microbiological Water Quality Station 7" shows that these counts are far lower than they were during 1965 or January-December 1966. During December 1966, however, the bacterial counts were much higher. Total coliforms averaged 1,440,000 per 100 ml, fecal streptococci averaged 46,700 per 100 ml and fecal coliform averaged 410,000 per 100 ml. The graph shows that these averages are equal to or higher than the averages of 1965 and January to June 1966. This improvement followed by a regression back to previous pollution levels was probably due to chlorination which was discontinued in December.

Table 7 indicates that there has been some improvement for some of the chemical parameters. However, organic nitrogen, total iron, phenols, suspended solids and dissolved solids all increased sharply in December.

Although some progress was made since 1965, most of the recommended criteria were not met. The median BOD of 6.2 mg/l remained the same as in 1965 but the maximum of 89 mg/l was far above the criteria which calls for a maximum of 10 mg/l.

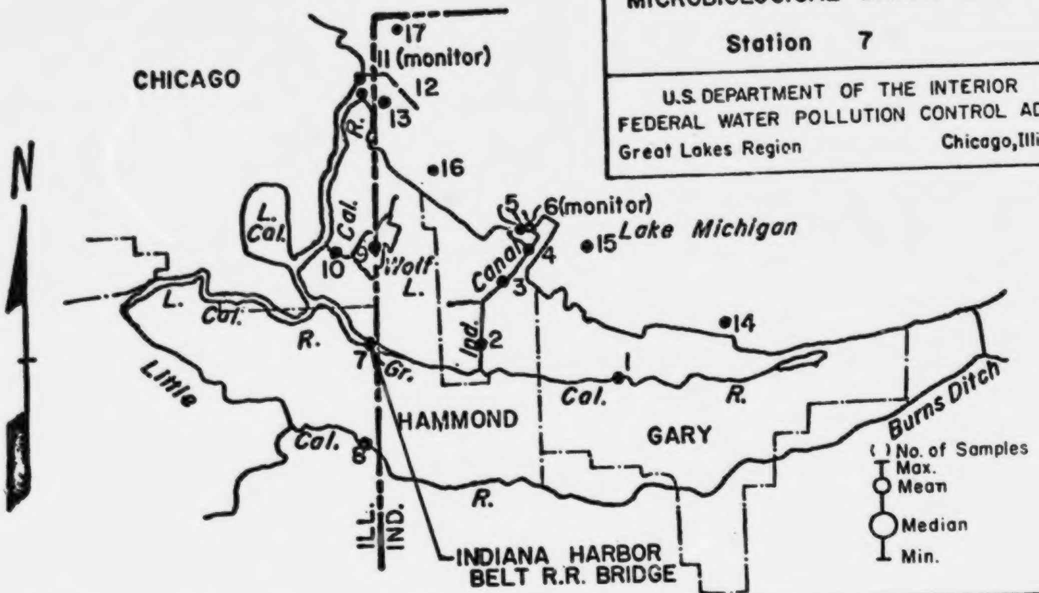
Dissolved oxygen did not change substantially since 1965 but many readings were below the minimum of 1.0 mg/l.

CALUMET AREA SURVEILLANCE PROJECT

MICROBIOLOGICAL WATER QUALITY

Station 7

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN
Great Lakes Region Chicago, Illinois



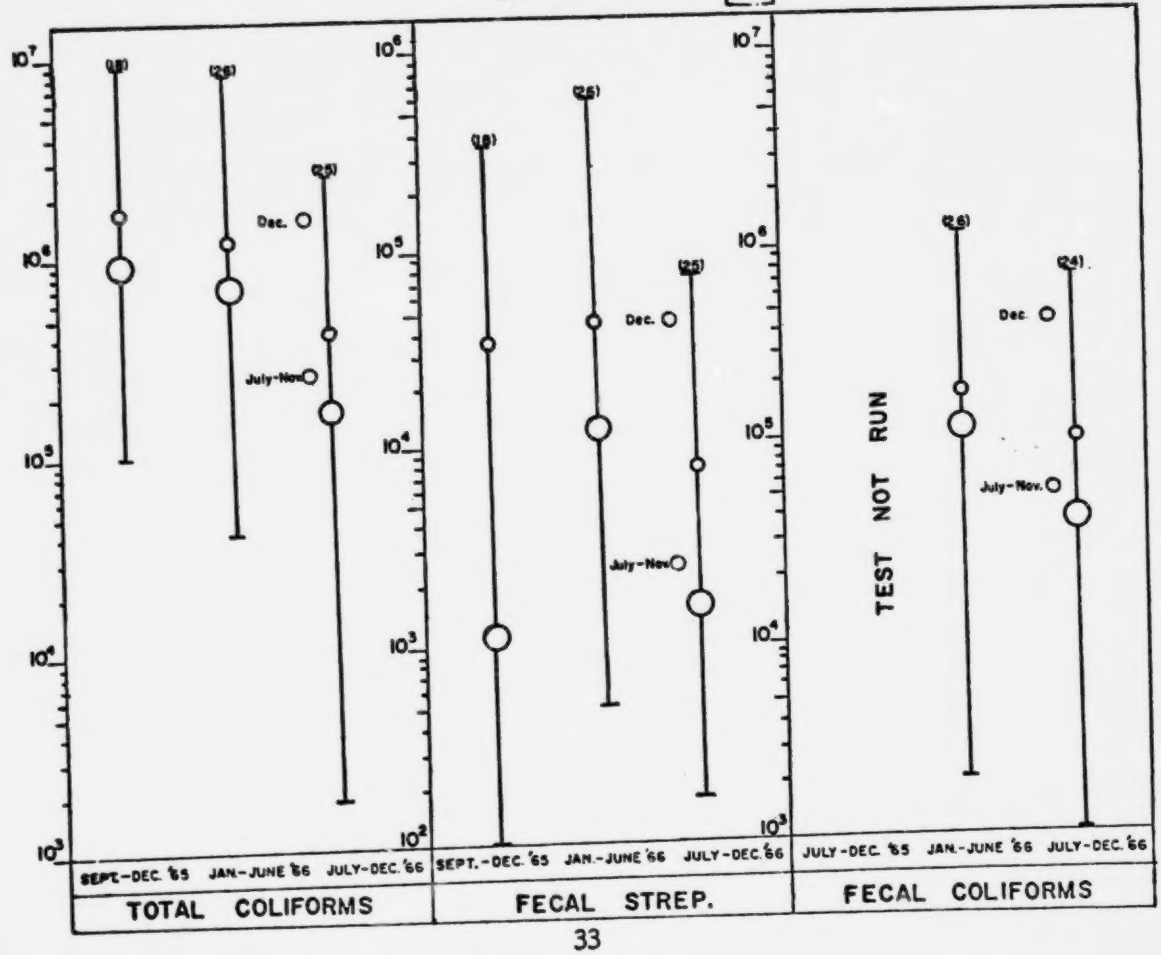


TABLE 7

CHEMICAL QUALITY OF WATER
STATION 7 - GRAND CALUMET RIVER AT INDIANA HARBOR BELT R.R. BRIDGE GC 328.5

Parameter		Sep. 1965-Dec. 1965				Jan. 1966-June 1966				July 1966-Dec. 1966			
		Max	Min	Mean	Median	Max	Min	Mean	Median	Max	Min	Mean	Median
Water Temp.	°C	21	5	13.4	16	23	3	11	9	28	5	17.0	17
pH		7.4	6.5	-	7.2	8.2	6.8	-	7.2	7.3	7.0	-	7.2
Conductivity	umho/cm	-	-	-	-	1150	410	922	1020	1500	690	975	940
Alkalinity	mg/1	-	-	-	-	-	-	-	-	253	121	181	170
DO	"	8.0	0.0	4.12	4.7	6.4	0.00	4.00	4.2	9.6	.5	4.12	3.65
BOD	"	24.0	3.5	8.3	6.1	104	3.2	26.4	21	89.0	2.6	13.3	6.2
COD	"	155	15	56.4	52	224	25	67	56	114	13	47.6	41
Sulphates	"	282	52	174	190	280	76	187	192	205	115	169	174
Chlorides	"	-	-	-	-	180	22	87	85	150	52	77	78
MBAS	"	-	-	-	-	1.8	.15	.70	.63	1.14	0.54	0.74	0.70
NH_3-N	"	11.0	1.2	4.6	3.2	12	0.55	4.72	3.9	13.0	0.3	3.7	2.4
NO_2+NO_3-N	"	13.00	1.2	5.0	3.8	15	1.1	6.3	6.4	14.0	1.6	6.4	5.0
Org. N	"	4.60	.05	1.70	1.60	6.6	0.6	2.4	1.9	11.9	0.5	2.1	1.1
Sol PO_4	"	11.0	1.25	5.9	5.9	10.1	0.3	2.9	2.0	16.0	0.7	8.9	8.4
Total PO_4	"	14.0	3.3	8.2	7.9	16.0	0.90	7.67	7.0	17.0	4.3	10.9	11.0
Iron	"	17.00	.27	2.01	0.80	7.9	0.6	2.13	1.3	3.10	0.26	0.73	0.49
Cyanide	"	.12	0.0	.01	0.0	0.05	0.0	.0096	.01	0.04	0.00	0.01	0.01
Sus. Solids	"	155	7	27.4	18	110	5	38	28	51	4	15.8	13
Dis. Solids	"	750	185	606	660	770	270	668	700	740	90	560	590
Phenol	ug/1	45.5	4.	15.4	13	90	3.1	24.4	19	66.0	3.0	12.3	8.0
Turbidity	units	-	-	-	-	19.5	1.8	6.2	5.1	30.0	1.0	4.74	2.2
		Data based on 18 samples				Data based on 26 samples				Data based on 25 samples			

COD was reduced from a median of 52 mg/l in 1965 to 41 mg/l in 1966 and sulphates from 190 mg/l to 174 mg/l.

The average chlorides content of 77 mg/l was only slightly above the permitted 75 mg/l and the maximum of 125 mg/l was violated only once in the last six months of 1966.

MBAS was far above the criteria. The minimum value of 0.54 mg/l is above the recommended maximum of 0.5 mg/l.

Ammonia nitrogen improved since 1965, dropping from an average of 4.6 mg/l to 3.7 mg/l, but the maximum limit of 5.0 mg/l was exceeded several times, especially in December.

Total and soluble phosphates both increased since 1965; soluble phosphate from an average of 5.9 mg/l to 8.9 mg/l and total phosphate from an average of 8.2 mg/l to 10.9 mg/l. A criterion for phosphate has not yet been recommended.

Total iron decreased substantially but cyanide was detected more often in 1966 than in 1965.

Suspended and dissolved solids both decreased but dissolved solids were above the recommended maximum of 500 mg/l.

The phenolic content decreased to an average of 12.3 µg/l in 1966, but the maximum allowable of 20 µg/l was exceeded in all three December 1966 samples.

Floating oil, sludge banks and gas bubbles were frequently reported at this station.

The water quality of the stream had shown considerable improvement during 1966 and several parameters were approaching their criteria levels until December when concentrations rose sharply.

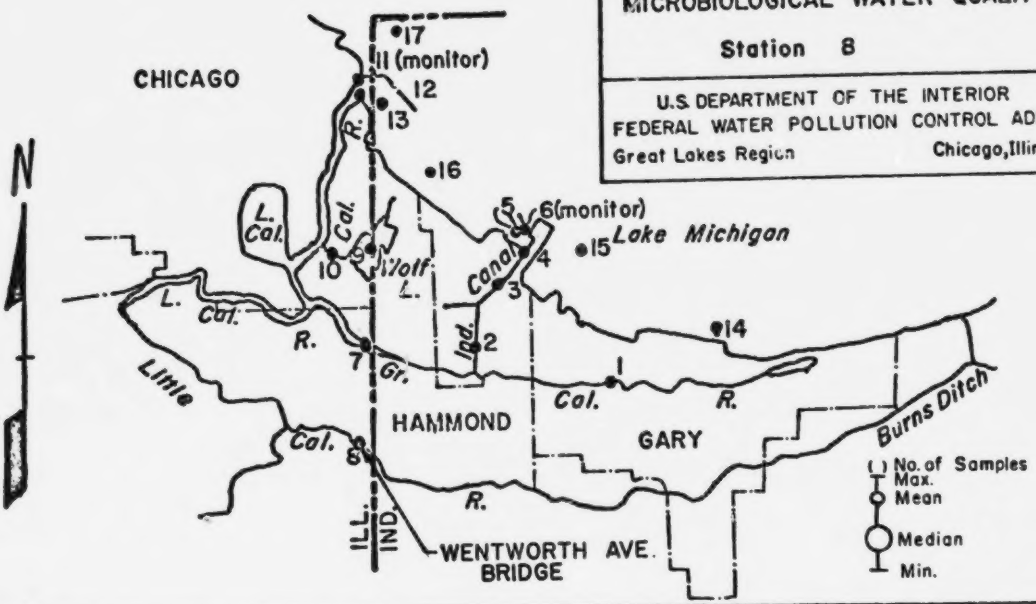
The samples for this station were composited on a monthly basis and analyzed for heavy metals. The following are average values for the last six months of 1966:

Cadmium	less than	0.005	mg/l
Copper		0.03	"
Potassium		9.3	"
Chrome	less than	0.005	"
Manganese		0.09	"
Lead	less than	0.005	"
Nickel		0.01	"
Arsenic	less than	0.001	"
Zinc		0.04	"
Sodium		79	"

CALUMET AREA SURVEILLANCE PROJECT

MICROBIOLOGICAL WATER QUALITY
Station 8

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN
Great Lakes Region Chicago, Illinois



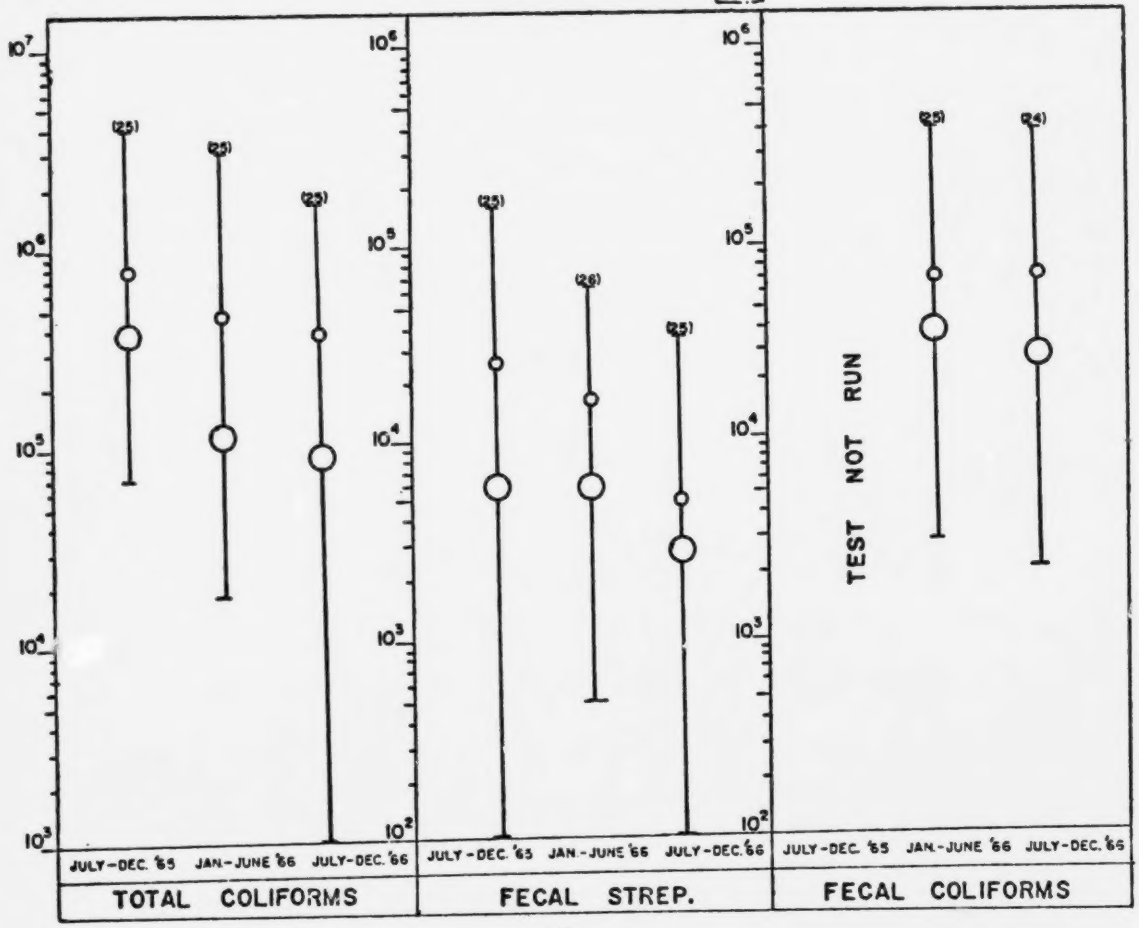


TABLE 8

CHEMICAL QUALITY OF WATER
STATION 8 - LITTLE CALUMET RIVER AT WENTWORTH AVE.-LC 332.3

		July 1965-Dec. 1965				Jan. 1966-June 1966				July 1966-Dec. 1966			
Parameter		Max	Min	Mean	Median	Max	Min	Mean	Median	Max	Min	Mean	Median
Water Temp.	°C	24	0	13.3	17	23	0	8	7	30	1	13.9	14
pH		8.8	7.1	-	7.4	8.0	7.0	-	7.5	8.1	6.9	-	7.5
Conductivity	umho/cm	-	-	-	-	1220	425	808	765	1300	430	1025	1100
Alkalinity	mg/1	-	-	-	-	-	-	-	-	307	65	220	242
DO	"	9.80	0.00	3.32	3.10	11.0	0.2	6.4	7.3	9.60	0.10	3.49	2.50
BOD	"	35.0	3.9	10.9	8.1	16	3.9	8.2	7.8	17.0	5.0	9.5	8.5
COD	"	151.0	5.9	50.9	51	89	20	45	39	72	19	45.7	50
Sulphates	"	310	57	175	175	300	101	187	180	325	100	216	205
Chlorides	"	-	-	-	-	55	17	41	44	80	18	52.3	54
MBAS	"	-	-	-	-	.76	.15	.28	.25	0.86	0.28	0.45	0.42
NH_3-N	"	3.70	.30	1.96	2.05	3.1	.35	1.4	1.4	6.0	0.3	2.57	2.4
NO_2+NO_3-N	"	5.40	.04	1.68	1.40	4.3	.12	1.7	1.8	9.3	0.10	1.62	0.60
Org. N	"	6.23	.13	2.58	1.60	2.95	0.8	1.7	1.4	7.2	0.3	1.78	1.5
Sol PO_4	"	9.71	.26	3.07	2.90	3.1	0.0	1.4	1.1	9.9	0.6	5.5	5.7
Total PO_4	"	14.28	1.10	4.60	4.30	6.9	.22	3.5	3.0	11.0	1.8	6.3	6.4
Iron	"	3.80	0.45	1.26	0.91	3.1	.44	1.0	.91	2.30	0.38	0.75	0.63
Cyanide	"	.18	0.0	0.012	0.0	.02	.00	.005	.00	0.66	0.00	0.3	0.00
Sus. Solids	"	704	10	105.5	30	980	13	89	32	320	5	38.1	18
Dis. Solids	"	770	109	565	637	860	255	595	570	907	194	652	741
Phenol	ug/1	59.0	0.0	10.9	7.9	39	.24	12.4	9.3	65.0	1.0	9.6	6.1
Turbidity	unit	-	-	-	-	103	1.2	15.6	9.0	80.0	1.0	8.7	4.0
		Data based on 25 samples				Data based on 25 samples				Data based on 25 samples			

Station 8 - Little Calumet River at Wentworth Avenue

The Wentworth Avenue Station was established to monitor the wastes in the Little Calumet River flowing from Indiana to Illinois. The station is located approximately one half mile downstream from the State line and is one of the control points established by the Calumet Area Technical Committee.

Improvement in microbiological quality reported in the January-June 1966 report has continued. The graph on Page 36 shows that the coliform and fecal streptococci counts were slightly lower during the last half of 1966. This slight decrease is significant because an increase would normally be expected due to the higher temperatures. The average temperature during January-June 1966 was $8^{o}C$ and during July-December 1966 it was $13.9^{o}C$. There were still several total coliform counts over 1,000,000 per 100 ml, however, and all the counts were higher than the maximum bacterial criteria. Overflows from combined sewers are still a severe problem.

The chemical data reveal no clear trend. Some are higher, some are lower than in the preceding six months. Most do not meet the recommended criteria. The criteria for water temperature and pH were met. The dissolved oxygen is far below the minimum level called for by the criteria. The average BOD and COD both decreased slightly since 1965, as did suspended solids, iron and phenols. Sulphates, ammonia, phosphates, cyanide and dissolved solids all increased appreciably, however.

The recommended criterion for BOD calls for a maximum of 10.0 mg/l. This was exceeded on several occasions, especially during July and August.

The maximum of 0.5 mg/l for MBAS was also exceeded several times.

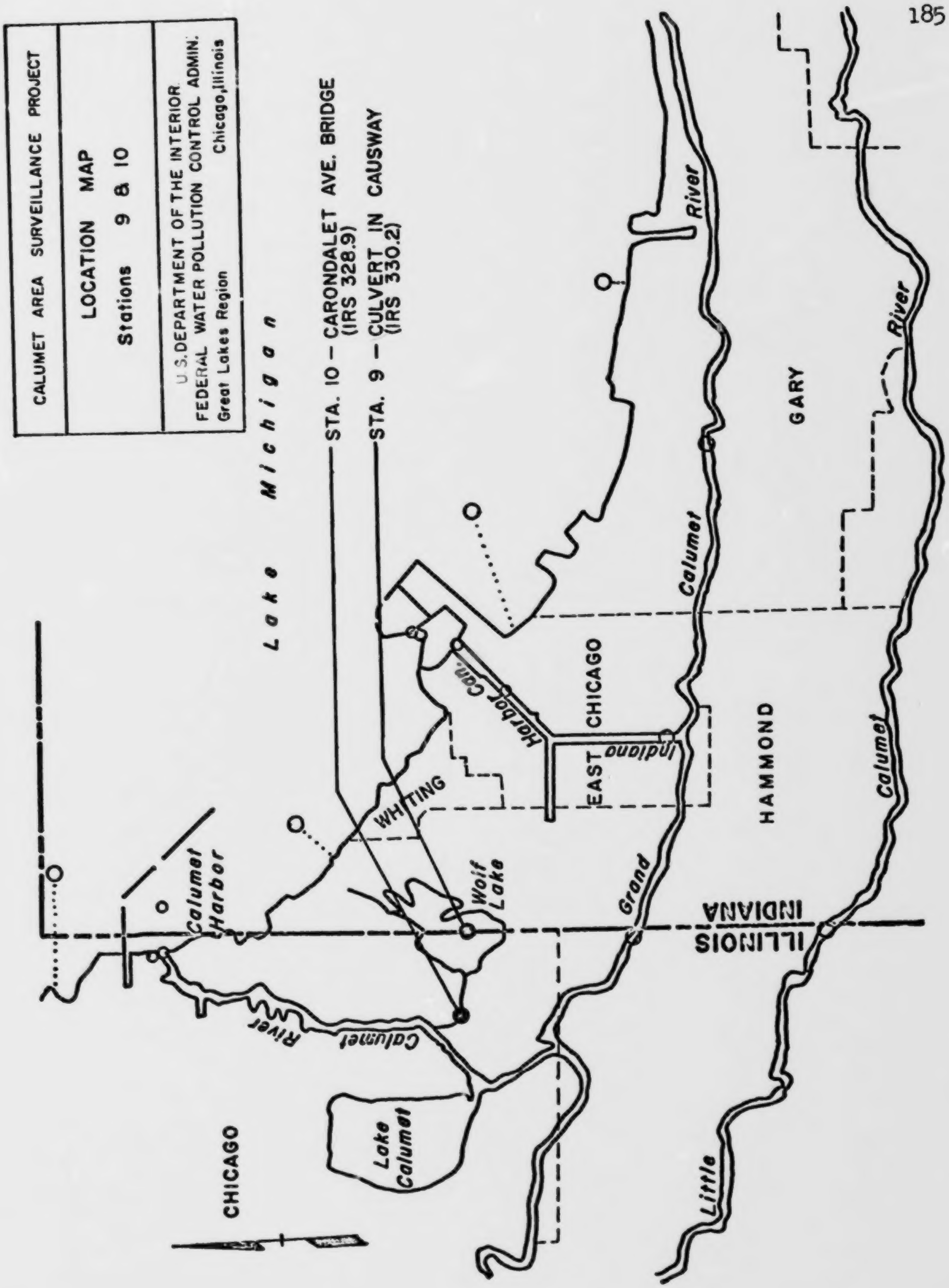
The criterion for ammonia nitrogen (maximum 1.5 mg/l) was exceeded on most of the samples.

The criterion for cyanides (maximum 0.025 mg/l) was generally met, except for one occasion when 0.66 mg/l was found.

The criterion for phenolic compounds (maximum 20 ug/l) was also generally met, except for one sample.

The criteria call for the stream to be substantially free of floating solids, sludge banks and visibly floating oil. Floating oil and solids have been frequently observed and gas bubbles indicate the presence of sludge banks.

Samples for this station were composited on a monthly basis and analyzed for heavy metals. The following are average values for the last six months of 1966:


CALUMET AREA SURVEILLANCE PROJECT
LOCATION MAP
Stations 9 & 10
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN.
Great Lakes Region
Chicago, Illinois
STA. 10 — CARONDALET AVE. BRIDGE (IRS 328.9)
STA. 9 — CULVERT IN CAUSWAY (IRS 330.2)
Lake Michigan
Calumet Harbor
WHITING
Wolf Lake
EAST CHICAGO
Harbor Can.
Indiana
HAMMOND
GARY
Grand
Calumet
River
Calumet
River
ILLINOIS
INDIANA
Calumet
River
Lake Calumet
CHICAGO
Little
Calumet
River

CALUMET AREA SURVEILLANCE PROJECT

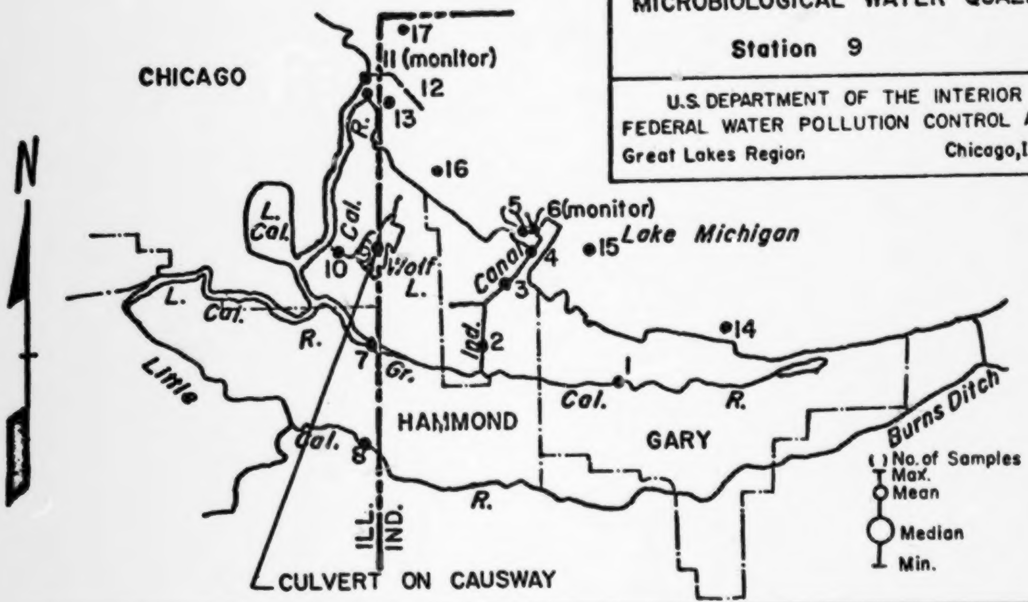
MICROBIOLOGICAL WATER QUALITY

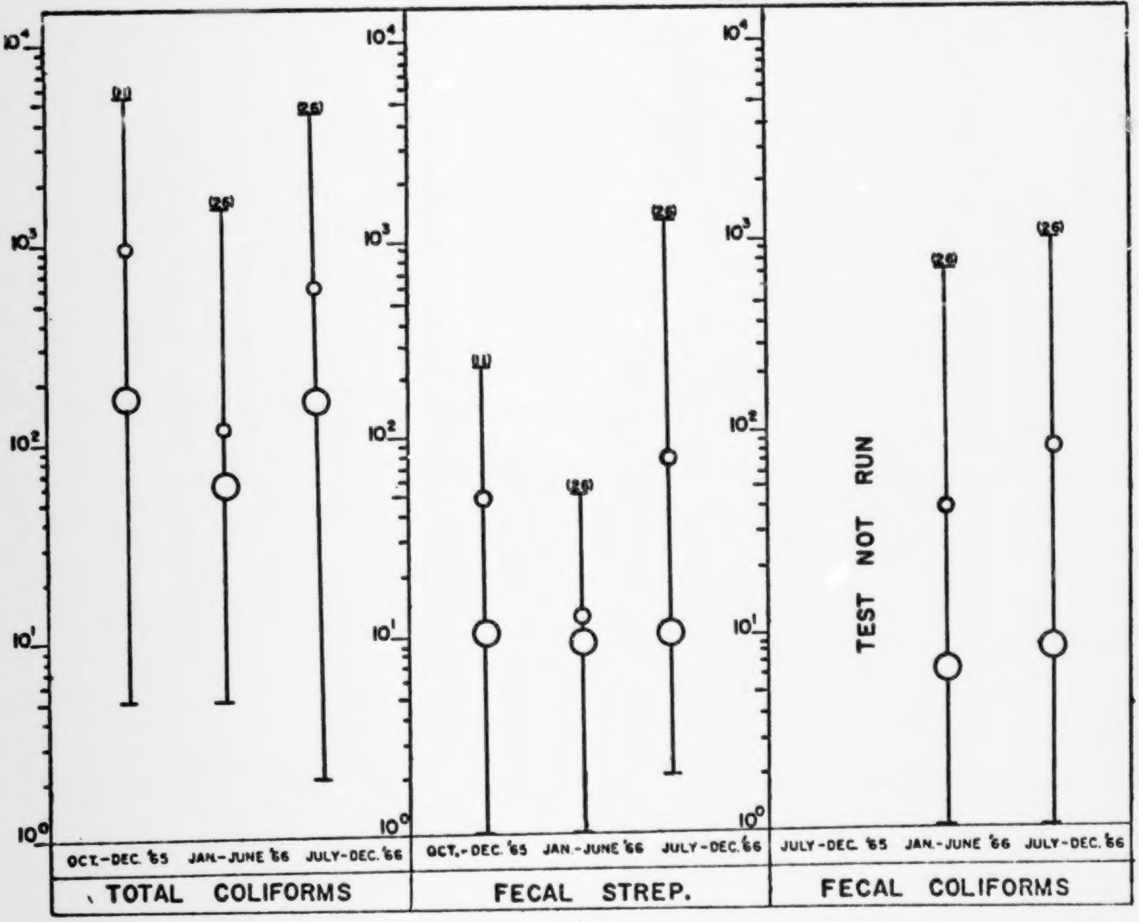
Station 9

U.S. DEPARTMENT OF THE INTERIOR

FEDERAL WATER POLLUTION CONTROL ADMIN

Great Lakes Region Chicago, Illinois



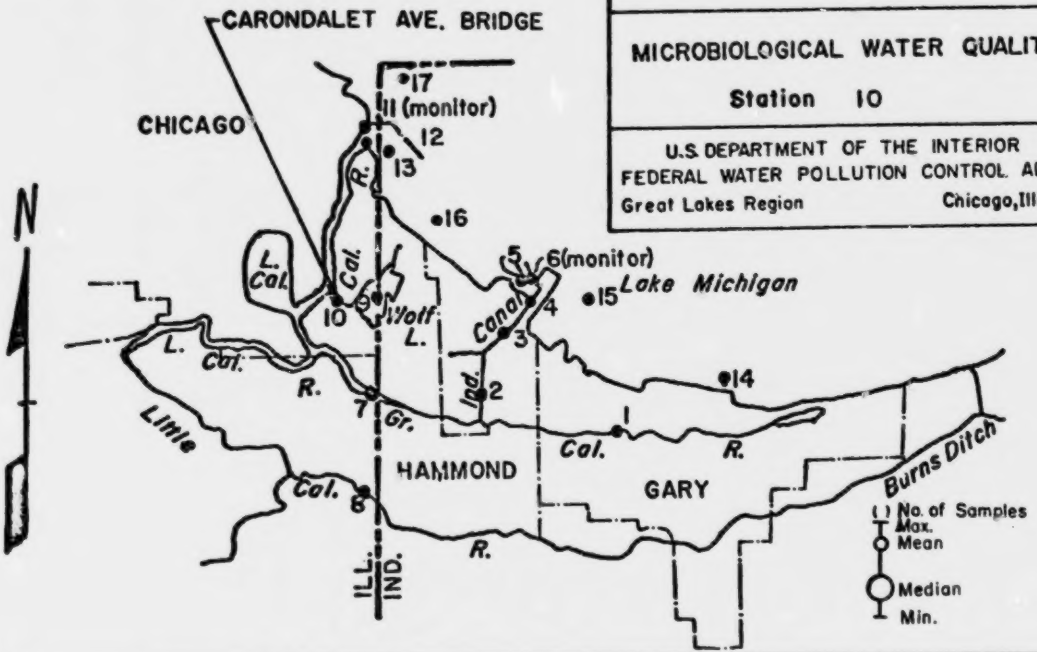


CALUMET AREA SURVEILLANCE PROJECT

MICROBIOLOGICAL WATER QUALITY

Station 10

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN
Great Lakes Region Chicago, Illinois



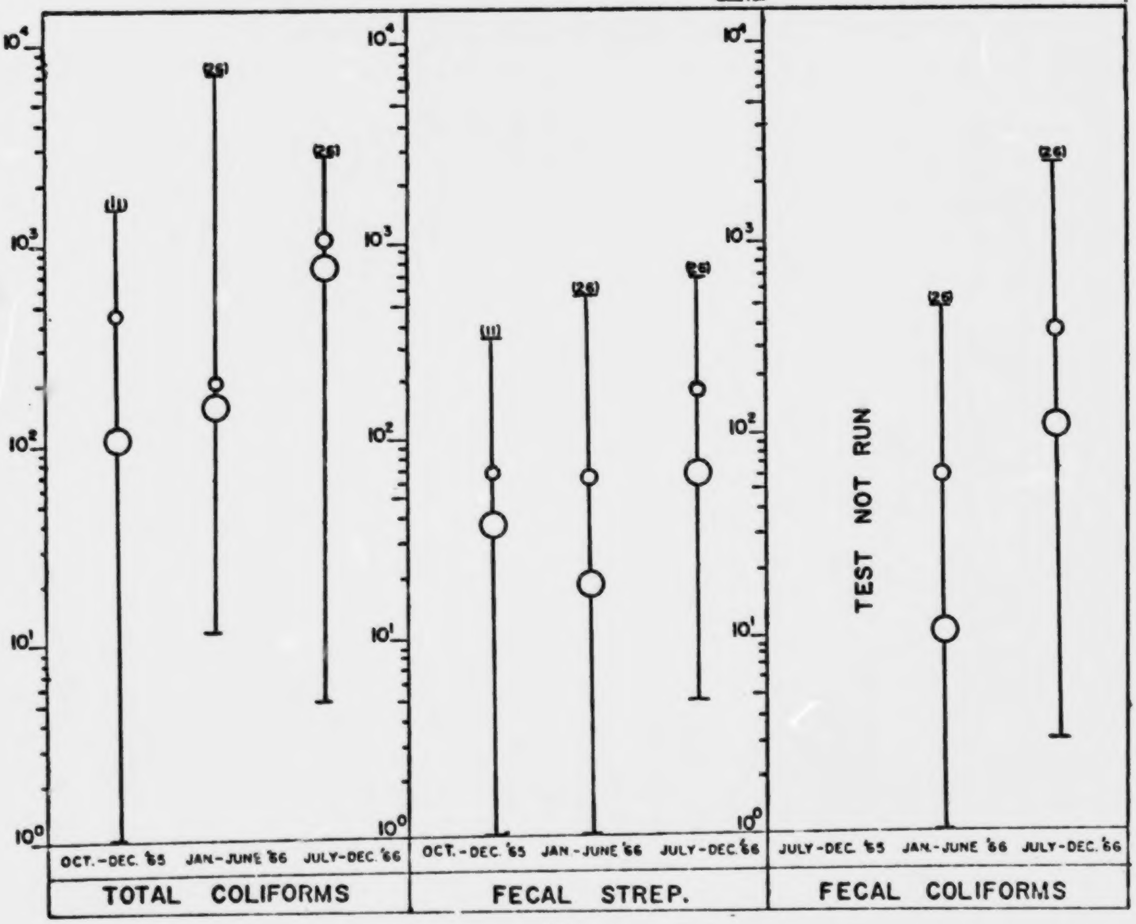


TABLE 9

CHEMICAL QUALITY OF WATER
STATION 9 - WOLF LAKE AT CULVERT ON INDIANA-ILLINOIS STATE LINE-IRS 330.2

Parameter		Oct. 1965-Dec. 1965				Jan. 1966-June 1966				July 1966-Dec. 1966			
		Max	Min	Mean	Median	Max	Min	Mean	Median	Max	Min	Mean	Median
Water Temp.	°C	15	0	4.1	1	24	0	8	5	29	0	13	12
pH		8.2	7.7	-	7.9	9.8	7.5	-	8.0	8.9	7.4	-	8.1
Conductivity	umho/cm	-	-	-	-	460	350	414	400	500	335	391	385
Alkalinity	mg/l	-	-	-	-	-	-	-	-	450	92	156	111
DO	"	15.0	10.0	12.6	13.0	15	7.70	11.04	11.2	14.20	7.10	10.53	10.52
BOD	"	5.5	1.2	3.2	3.4	7.8	1.9	3.9	3.7	11.0	1.6	5.6	6.0
COD	"	134	6.4	42	23	26	10	18	18	55	15	32.5	30
Sulphates	"	60	46	50	50	69	45	55	55	61	37	46.6	46
Chlorides	"	-	-	-	-	38	27	31	30	34	20	26.8	27
MBAS	"	-	-	-	-	.19	.10	.12	.11	0.19	0.09	0.14	0.14
NH_3-N	"	0.38	0.07	0.24	0.22	.56	.02	.28	.30	0.54	0.03	0.22	0.20
NO_2+NO_3-N	"	0.86	0.38	0.58	0.55	1.2	.03	.38	.30	0.99	0.10	0.34	0.26
Org. N	"	1.00	0.45	0.69	0.68	1.19	.51	.76	.71	2.00	0.55	1.20	1.10
Sol PO_4	"	0.29	0.02	0.10	0.09	.07	.00	.02	.02	0.29	0.05	0.14	0.14
Total PO_4	"	0.30	0.06	0.13	0.12	.34	.04	.11	.08	0.48	0.08	0.20	0.19
Iron	"	0.97	0.08	0.28	0.23	.56	.04	.24	.22	0.74	0.05	0.25	0.24
Cyanide	"	0.01	0.00	0.00	0.00	.35	.00	.01	.00	0.03	0.00	0.001	0.00
Sus. Solids	"	51	2	11	9	48	4	13	9	31	4	15.3	14
Dis. Solids	"	285	255	264	265	320	180	268	265	275	184	230	225
Phenol	ug/l	20	0.00	4.2	4	19	.14	3.05	2	18	0	3.4	3
Turbidity	units	-	-	-	-	4.2	0.5	2.3	2.1	12.0	1.3	4.2	4.0
		Data based on 11 samples				Data based on 26 samples				Data based on 26 samples			

TABLE 10

CHEMICAL QUALITY OF WATER
STATION 10 - WOLF LAKE CHANNEL AT CARONDOLET AVE.-IRS 328.9

		Oct. 1965-Dec. 1965				Jan. 1966-June 1966				July 1966-Dec. 1966			
Parameter		Max	Min	Mean	Median	Max	Min	Mean	Median	Max	Min	Mean	Median
Water Temp.	°C	16	1	4.6	3	25	0	8	5	28	0	14	13
pH		8.6	8.1	-	8.4	8.8	7.9	-	8.5	8.7	8.0	-	8.4
Conductivity	umho/cm	-	-	-	-	545	370	463	460	520	350	440	445
Alkalinity	mg/1	-	-	-	-	-	-	-	-	121	83	104	102
DO	"	13	8.0	11.4	12.0	14.0	5.9	10.6	11.4	13.30	5.95	9.35	9.70
BOD	"	2.6	1.7	2.2	2.1	5.0	1.9	3.1	3.3	7.6	2.0	3.0	2.8
COD	"	138	0.8	31.6	20	26	12	18	18	38	11	25.6	27
Sulphates	"	72	45	63.6	66	92	69	77	77	82	52	68.4	68
Chlorides	"	-	-	-	-	37	30	34	35	42	26	33.7	32
MBAS	"	-	-	-	-	.24	.09	.13	.12	0.20	0.08	0.13	0.13
NH_3-N	"	0.33	0.06	0.20	0.21	0.67	0.10	0.27	0.28	0.41	0.01	0.18	0.18
NO_2+NO_3-N	"	0.60	0.12	0.30	0.26	0.67	0.10	0.37	0.34	0.63	0.01	0.23	0.21
Org. N	"	0.83	0.44	0.58	0.55	1.11	0.35	0.70	0.62	1.05	0.28	0.69	0.74
Sol PO_4	"	0.24	0.02	0.09	0.05	0.24	0.00	0.03	0.02	0.11	0.03	0.07	0.07
Total PO_4	"	0.49	0.05	0.13	0.08	0.27	0.03	0.07	0.06	0.15	0.06	0.09	0.09
Iron	"	0.37	0.04	0.20	0.22	0.77	0.05	0.23	0.23	0.27	0.04	0.15	0.15
Cyanide	"	None found				0.02	0.00	0.002	0.00	0.01	0.00	0.00	0.00
Sus. Solids	"	24	2	13	15	65	2	25	24	58	3	16.2	14
Dis. Solids	"	305	245	281	280	315	220	289	295	343	172	258	260
Phenol	ug/1	8	0	3.6	3	15	1.4	6.8	8.0	20.0	1.0	5.4	3.5
		Data based on 11 samples				Data based on 26 samples				Data based on 26 samples			

Cadmium	less than	0.005	mg/l
Copper		0.07	"
Potassium		6.8	"
Chrome		0.06	"
Manganese		0.23	"
Lead		0.02	"
Nickel		0.20	"
Arsenic	less than	0.001	"
Zinc		0.03	"
Sodium		68	"

Stations 9 and 10 - Wolf Lake and Outlet

Wolf Lake, which is located on the Indiana-Illinois State line, has been sampled at two points. Station 9 is directly on the State line which runs along a causeway that bisects the lake. This station monitors the quality of the water crossing the State line and has been established as a control point by the Calumet Area Technical Committee. Station 10 is located on the Wolf Lake outlet at Carondolet Avenue about 3,000 feet downstream from Wolf Lake and monitors the quality of the water leaving the lake.

The quality of the water in Wolf Lake and its outlet is good. At Station 9 the recommended criteria for total coliforms and fecal streptococci were met approximately 95 percent of the time during 1966. Runoff is the probable cause of the higher counts. On two of the three occasions they were not met; it was either raining at or shortly before the time of sampling. The microbiological water quality graph for Station 9 on Page 186 shows that there was no change in the counts last year. The lower coliform counts in January-June 1966 can be attributed to lower water temperatures during this period. Dissolved oxygen in the lake was more than sufficient and the BOD was low.

Floating suds were observed periodically on Wolf Lake. On two occasions the problem was so severe as to prevent recreational use of the lake. Probable cause of these conditions is discharges of detergent from Lever Brothers Company. Concentrations of MBAS and phosphates were considerably above the recommended levels and reflect this problem. A maximum of 0.05 mg/l MBAS and an average of not more than 0.02 mg/l are recommended. Table 9 shows that the values were several times higher and appear to have increased. The increase in average MBAS concentration from 0.12 mg/l in January-June 1966 to 0.14 mg/l in July-December 1966 is significant because the higher temperatures in the July-December period should have caused more biological breakdown of MBAS and therefore lower counts. A similar comment can be made on the phosphate levels which rose from an average of 0.11 mg/l in the first half of 1966 to an average of 0.20 mg/l in the second half. In addition, the July-December 1966 phosphates were higher than for the corresponding period in 1965.

Concentrations of ammonia nitrogen in the lake were also above the recommended criteria. These concentrations have not changed since 1965. The ammonia may be due to runoff from the area around the lake. This high nitrogen content, when combined with the phosphates from the detergents discharged to the lake, could cause algal blooms and accelerate the process of eutrophication in the lake.

There has been no repetition of the cyanide contamination discussed in the previous report, but traces are still found occasionally in both the lake and its outlet.

In the lake outlet stream at Station 10, concentrations of DO, BOD, COD, ammonia, and phosphates were lower than in the lake -- probably due to stabilization reactions in the lake and the stream.

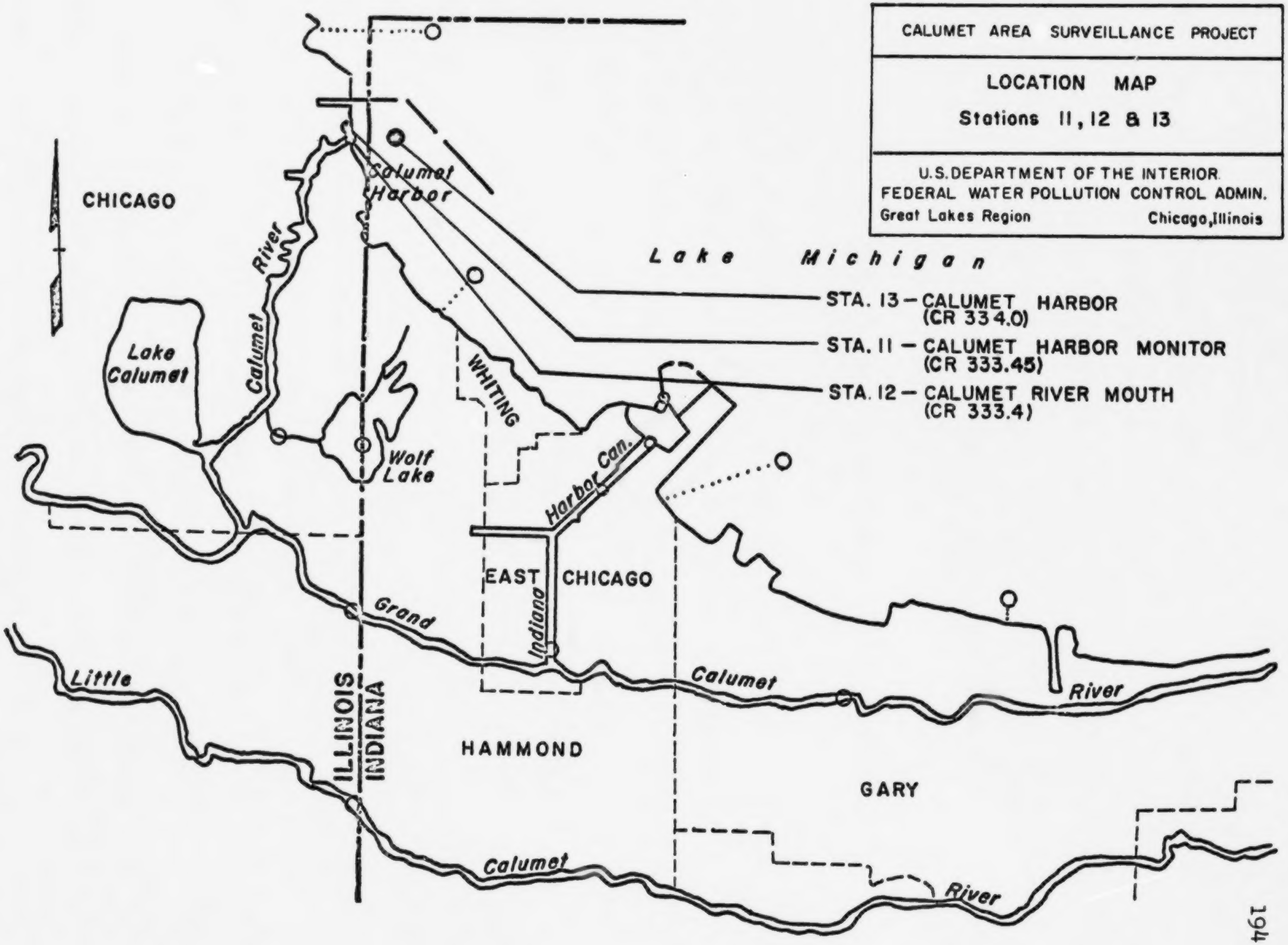
Both the phenols and the sulphates were consistently higher in the outlet than in the lake. The reason for this is not understood since there is no known source of waste between the two stations. The microbiological quality of the water at Station 10 was good but the total coliforms increased since 1965. Further investigations of these findings are planned.

Stations 11, 12 and 13 - Calumet Harbor

There are three sampling stations located at Calumet Harbor. Station 11 is located at the mouth of the Grand Calumet River immediately adjacent to the north pierhead light. The purpose of this station is to correlate the sampling program with a water quality monitor which is located in the pierhead light structure.

Station 12 is located at the mouth of the Grand Calumet River at midstream. The purpose of this station is to monitor the quality of the water entering the river from the harbor.

Station 13 is located in mid-harbor approximately 3,500 feet from the mouth of the river. This station monitors the quality of the water flowing in from Lake Michigan to the river. Stations 12 and 13 require a boat for sampling and therefore can be sampled only when weather permits.



CALUMET AREA SURVEILLANCE PROJECT

LOCATION MAP

Stations 11, 12 & 13

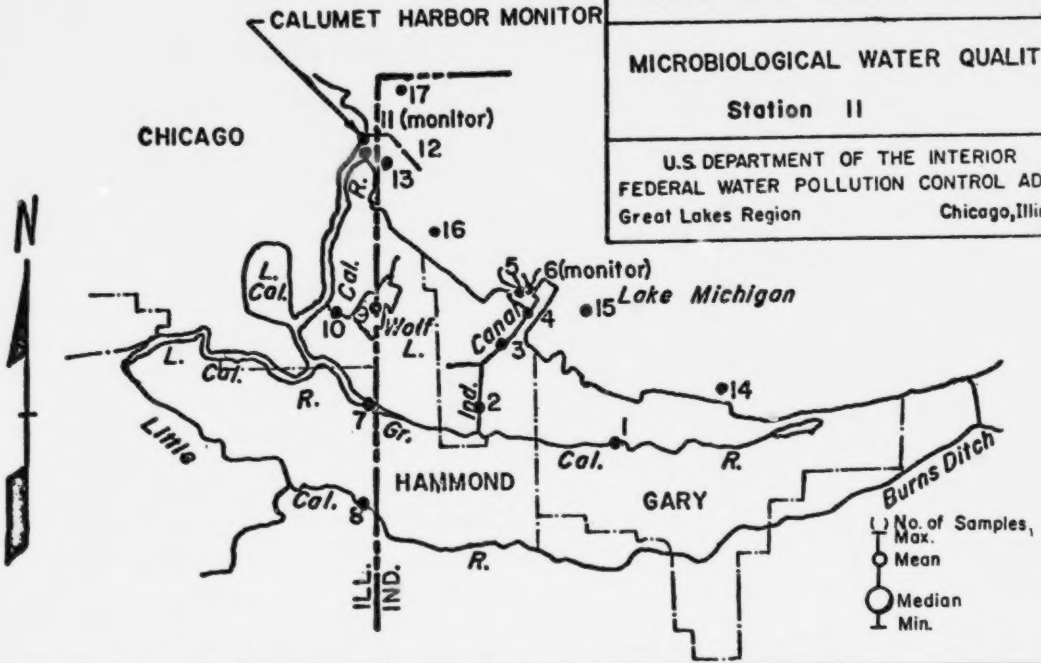
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN.
Great Lakes Region Chicago, Illinois

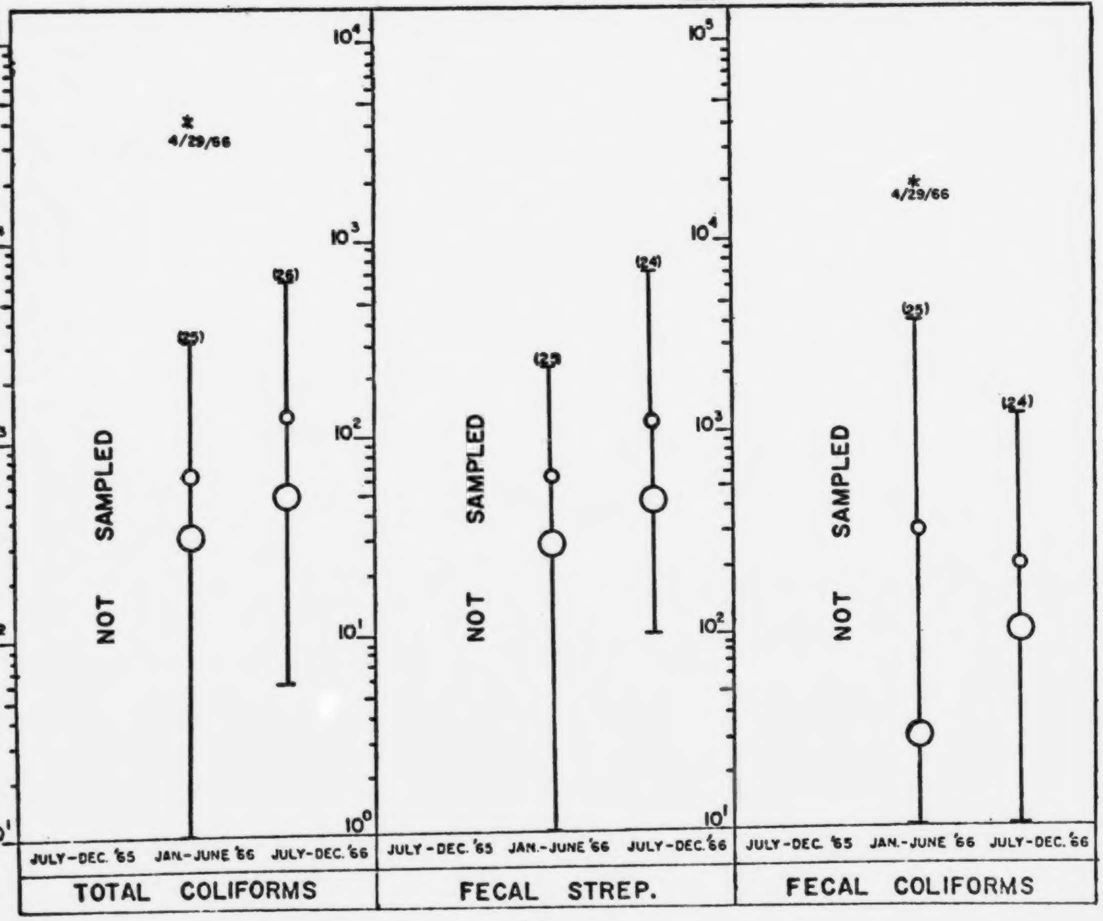
CALUMET AREA SURVEILLANCE PROJECT

MICROBIOLOGICAL WATER QUALITY

Station 11

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN
Great Lakes Region Chicago, Illinois



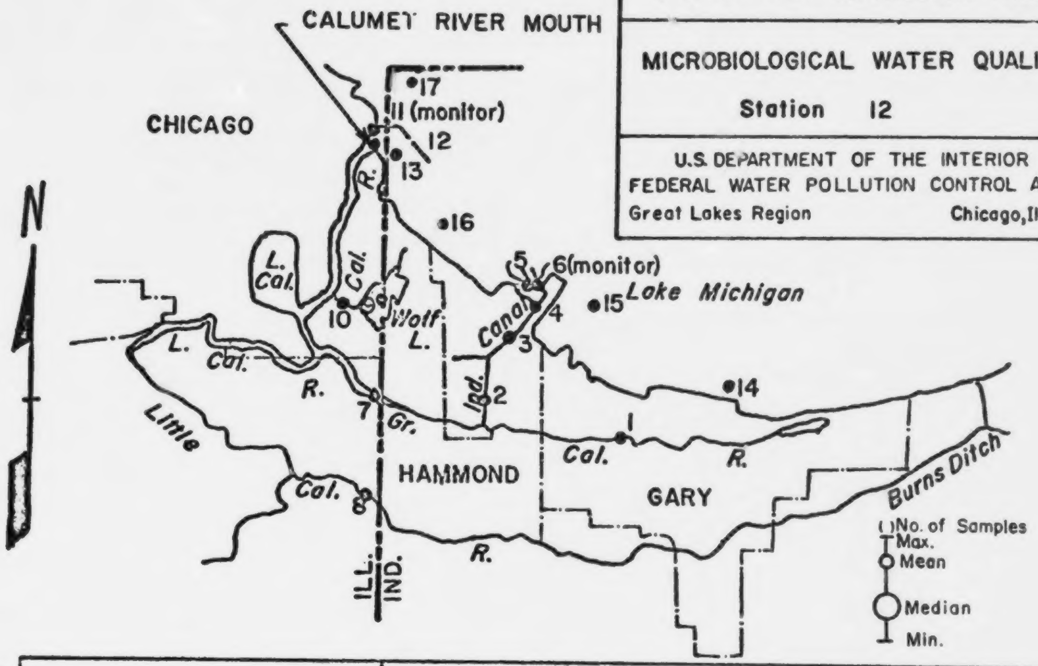


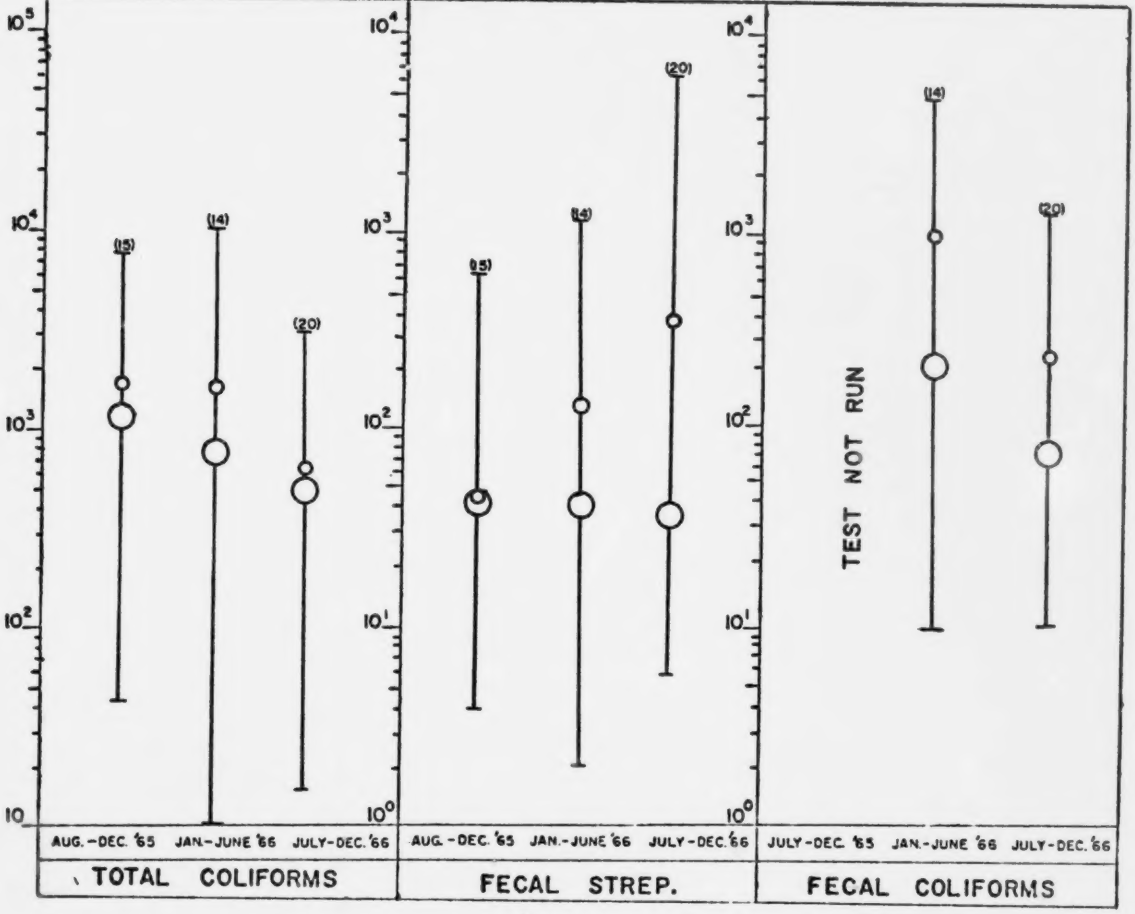
CALUMET AREA SURVEILLANCE PROJECT

MICROBIOLOGICAL WATER QUALITY

Station 12

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN
Great Lakes Region Chicago, Illinois





CALUMET AREA SURVEILLANCE PROJECT

MICROBIOLOGICAL WATER QUALITY

Station 13

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN
Great Lakes Region Chicago, Illinois

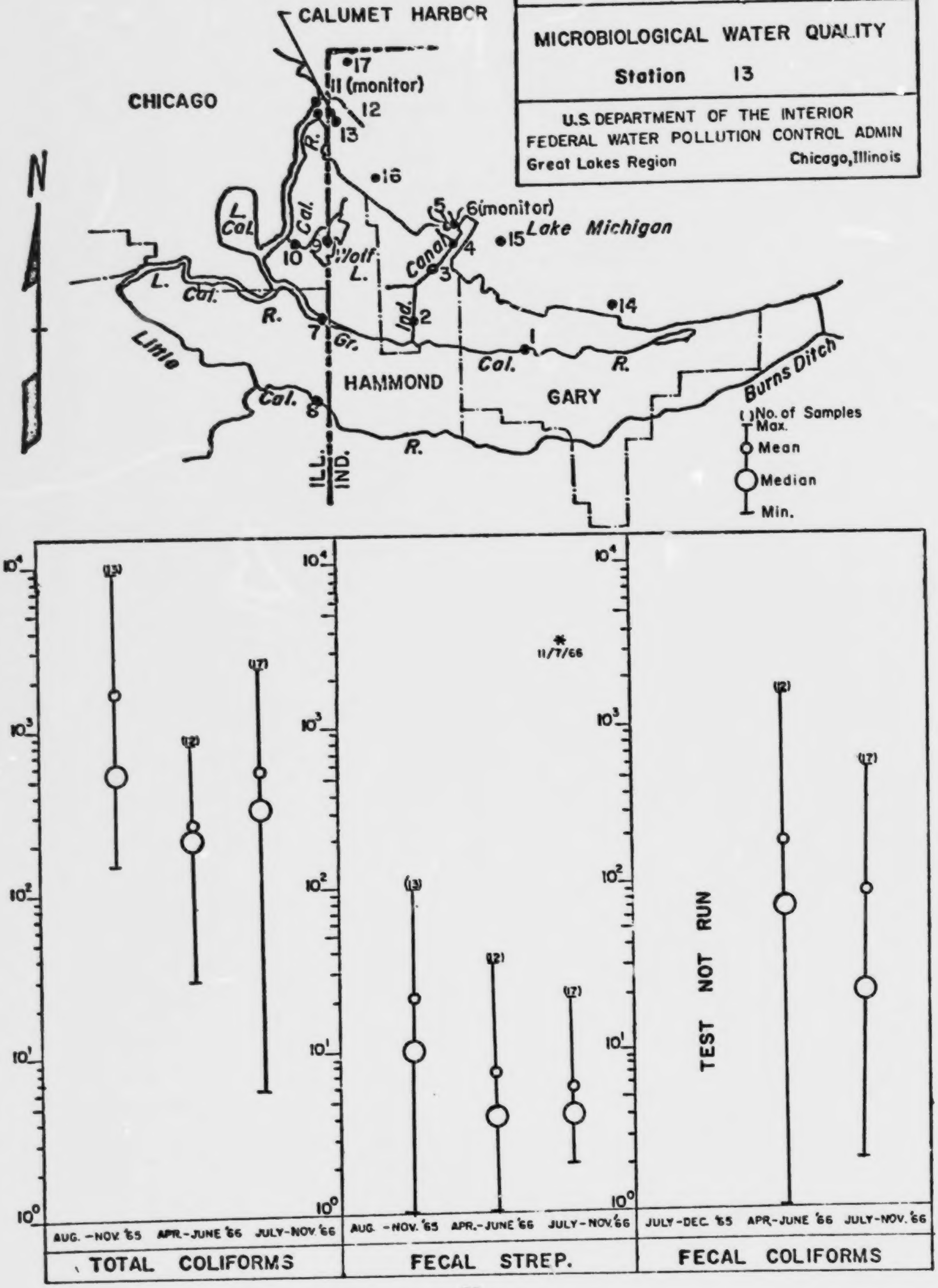


TABLE 11

CHEMICAL QUALITY OF WATER

STATION 11 - CALUMET RIVER AT NORTH PIERHEAD LIGHT-CR 333.45
(WATER QUALITY MONITORING STATION)

Parameter		July 1965-Dec. 1965 Max	 Min	 Mean	 Median	Jan. 1966-June 1966 Max	 Min	 Mean	 Median	July 1966-Dec. 1966 Max	 Min	 Mean	 Median
Water Temp.	°C	NOT SAMPLED IN 1965				19	0	7	6	26	1	15.3	15
pH						8.3	7.4	-	7.8	8.1	7.3	-	7.9
Conductivity	umho/cm					330	203	298	300	410	250	313	300
Alkalinity	mg/1					-	-	-	-	133	88	106	106
DO	"					14.1	4.2	10.1	10.4	12.65	4.85	8.10	7.70
BOD	"					4.9	0.9	2.5	2.2	5.6	1.1	2.6	2.5
COD	"					36	0.7	9.5	8.8	42	5	16	15
Sulphates	"					35	21	27	27	38	16	26.4	28
Chlorides	"					16	10	12	12	25	9	11.8	10
MBAS	"					.22	.03	.07	.05	0.14	0.02	0.08	0.08
NH_3-N	"					0.72	0.21	0.49	0.46	1.10	0.12	0.35	0.29
NO_2+NO_3-N	"					0.32	0.09	0.20	0.22	.70	.09	.24	.19
Org. N	"					0.70	0.05	0.34	0.31	0.64	0.03	0.31	0.29
Sol PO_4	"					0.78	0.00	0.11	0.04	0.79	0.01	0.07	0.04
Total PO_4	"					0.90	0.04	0.17	0.09	1.10	0.04	0.18	0.10
Iron	"					8.6	0.09	2.1	1.1	97.00	.69	13.2	2.1
Cyanide	"					0.13	0.00	0.02	0.01	0.02	0.00	0.00	0.00
Sus. Solids	"					85	8	29	23	191	3	41	20
Dis. Solids	"					210	160	182	185	211	80	172	177
Phenol	ug/1					15	0.6	2.9	2.7	19.0	0.0	4.0	2
Turbidity	units					-	-	-	-	90.0	.6	35.0	12.5
						Data based on 25 samples				Data based on 26 samples			

TABLE 12

CHEMICAL QUALITY OF WATER
STATION 12 - CALUMET RIVER AT MOUTH - PIERHEAD LIGHTS-CR 333.4

		Aug.-1965-Dec. 1965				Jan. 1966-June 1966				July 1966-Dec. 1966			
Parameter		Max	Min	Mean	Median	Max	Min	Mean	Median	Max	Min	Mean	Median
Water Temp.	°C	22	3	13.6	14	19	4	11	11	24	2	17.7	21
pH		8.0	7.5	-	7.9	8.1	7.5	-	7.9	8.0	7.2	-	7.8
Conductivity	umho/cm	-	-	-	-	330	285	300	295	330	285	304	300
Alkalinity	mg/1	-	-	-	-	117	110	113	113	211	93	113	109
DO	"	6.78	13.00	8.80	8.50	11.1	5.40	8.46	7.85	12.40	1.60	7.55	7.30
BOD	"	3.7	1.0	1.92	2.2	5.5	1.0	2.8	2.2	28	0.4	3.87	2.1
COD	"	120	0.9	28.7	12	18	1.6	10.4	10	39	12	14.4	6
Sulphates	"	26	17	23	23	30	18	25	25	32	16	24.2	25
Chlorides	"	-	-	-	-	16	9	12	12	18	9	10.7	10
MBAS	"	-	-	-	-	.10	.03	.06	.05	0.12	0.03	0.07	0.07
NH_3-N	"	0.39	0.15	0.20	0.22	0.68	0.35	0.50	0.50	0.55	0.08	0.30	0.31
NO_2+NO_3-N	"	0.41	0.17	0.23	0.27	0.35	0.09	0.20	0.21	0.50	0.09	0.27	0.26
Org. N	"	0.60	0.04	0.24	0.29	3.23	0.07	0.56	0.33	0.52	0.01	0.27	0.28
Sol PO_4	"	0.23	0.02	0.07	0.07	0.09	0.01	0.04	0.04	0.05	0.01	0.04	0.04
Total PO_4	"	0.25	0.02	0.11	0.09	0.13	0.05	0.08	0.08	0.23	0.04	0.09	0.07
Iron	"	2.30	0.24	0.84	0.72	1.8	0.55	1.10	1.10	7.1	0.44	1.72	1.2
Cyanide	"	0.01	0.00	0.00	0.00	0.12	0.00	0.01	0.01	0.01	0.00	0.00	0.00
Sus. Solids	"	76	2.0	19.6	18	53	4	20	17	88	6	21.8	12
Dis. Solids	"	280	140	180	170	235	175	192	185	200	155	179	170
Phenol	ug/1	8.2	0.00	2.31	2.0	12	0.0	1.9	0.6	5	0	2.1	2
		Data based on 15 samples				Data based on 13 samples				Data based on 20 samples			

TABLE 13

CHEMICAL QUALITY OF WATER
STATION 13 - CALUMET HARBOR AT MID-CHANNEL-CR 334.0

Parameter		Aug. 1965-Nov. 1965				Apr. 1966-June 1966				July 1966-Nov. 1966			
		Max	Min	Mean	Median	Max	Min	Mean	Median	Max	Min	Mean	Median
Water Temp.	°C	22	7	15	15	18	5	12	14	24	7	19.1	22
pH		8.0	7.7	-	7.9	8.1	7.4	-	7.8	8.0	7.6	-	7.8
Conductivity	umho/cm	-	-	-	-	310	270	293	300	315	275	298	295
Alkalinity	mg/1	-	-	-	-	121	107	113	111	212	96	115	111
DO	"	11.0	6.95	8.84	9.00	12.2	7.3	9.2	9.3	11.40	6.20	8.11	7.65
BOD	"	2.1	1.0	1.5	1.6	4.8	1.3	2.6	2.3	3.4	1.0	2.1	2.0
COD	"	120	0.0	18.6	7.6	16	3.0	9.2	10	22	2	12.7	14
Sulphates	"	37.0	19	24.8	24	26	18	24	25	33	16	23.7	25
Chlorides	"	-	-	-	-	14	8	11	11	12	9	10	10
MBAS	"	-	-	-	-	.09	.03	.05	.04	0.11	0.02	0.06	0.06
NH_3-N	"	0.27	0.10	0.19	0.20	0.48	0.24	0.33	0.33	0.47	0.04	0.25	0.24
NO_2+NO_3-N	"	0.53	0.17	0.26	0.24	0.35	0.08	0.18	0.16	0.38	0.04	0.19	0.19
Org. N	"	0.53	0.03	0.25	0.22	0.56	0.10	0.37	0.39	0.37	0.06	0.22	0.23
Sol PO_4	"	0.29	0.02	0.07	0.05	0.05	0.00	0.02	0.02	0.07	0.01	0.03	0.03
Total PO_4	"	0.78	0.02	0.14	0.09	0.10	0.04	0.06	0.06	0.08	0.04	0.06	0.06
Iron	"	1.82	0.09	0.46	0.21	2.1	0.29	0.66	0.48	1.80	0.12	0.50	0.47
Cyanide	"	0.01	0.0	0.001	0.00	0.01	0.00	.002	0.00	0.01	0.00	0.00	0.00
Sus. Solids	"	19.0	1.0	9.3	8.0	46	3	12	9	23	2	9	7
Dis. Solids	"	195	150	170	170	210	170	190	185	185	126	167	167
Phenol	ug/1	8.0	0.0	1.35	0.9	5.3	0.0	1.3	0.0	11	0	2.4	2
Turbidity	units	-	-	-	-	8.8	1.3	2.6	3.4	19.9	0.6	2.8	1.6
		Data based on 12 samples				Data based on 12 samples				Data based on 17 samples			

Operation of the O'Brien Lock tends to isolate the area by reversing the natural flow of the river, so that water flows from the lake to the river most of the time. For this reason most of the pollution in the harbor and at the river mouth originates in the immediate area.

The graphs on preceding pages show that the level of microbiological pollution was slightly less than in 1965. The higher counts in the last half of 1966 were due to the higher temperatures during the period. This area was not designated as a control point by the Technical Committee but the criteria for inner harbor basins could reasonably be applied.

The criteria for total coliform (maximum 5000 per 100 ml and average 2000 per 100 ml) were generally met at all three stations.

The criterion for fecal streptococci (maximum 100 per 100 ml) was not met approximately one third of the time at each station. High fecal coliform counts also occurred. On several occasions there were high fecal coliform to total coliform ratios. This indicates that the pollution is fresh, of animal origin and local in nature. A large number of ships and boats use the harbor.

Since flow is usually from the harbor to the river, industrial pollution in the harbor is not severe.

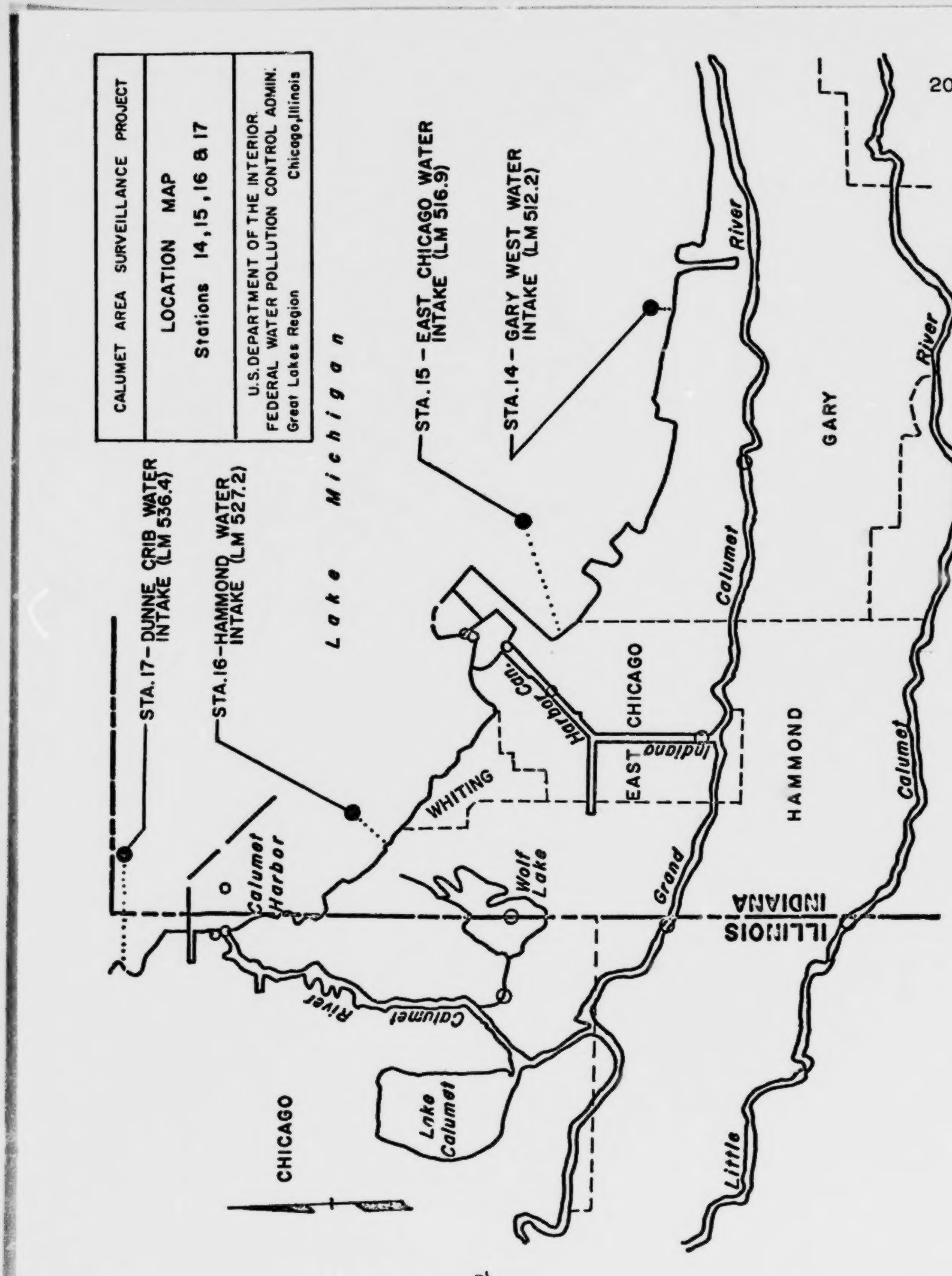
At Station 13, which is out in the harbor, all of the chemical criteria except pH and ammonia nitrogen were met.

The criteria for phosphates and iron were not met at the two stations in the river mouth; as Table 11 indicates, there were high concentrations of iron at Station 11. Iron from U.S. Steel outfalls to the harbor often discolored the entire area. This also created high turbidity. A comparison of the 1965 data with the July-December 1966 data reveals no significant changes except that ammonia nitrogen concentrations were higher in 1966 and phosphate concentrations were lower.

Except for the severe discoloration of the water around Station 11 by iron, pollution is less severe in Calumet Harbor than in Indiana Harbor.

Station 14 - Gary West Water Intake

The Gary West Water Intake is one of the control points designated by the Calumet Area Technical Committee for open Lake Michigan water. It was originally intended that the water filtration plant at which the samples are collected should perform the analyses at the raw water

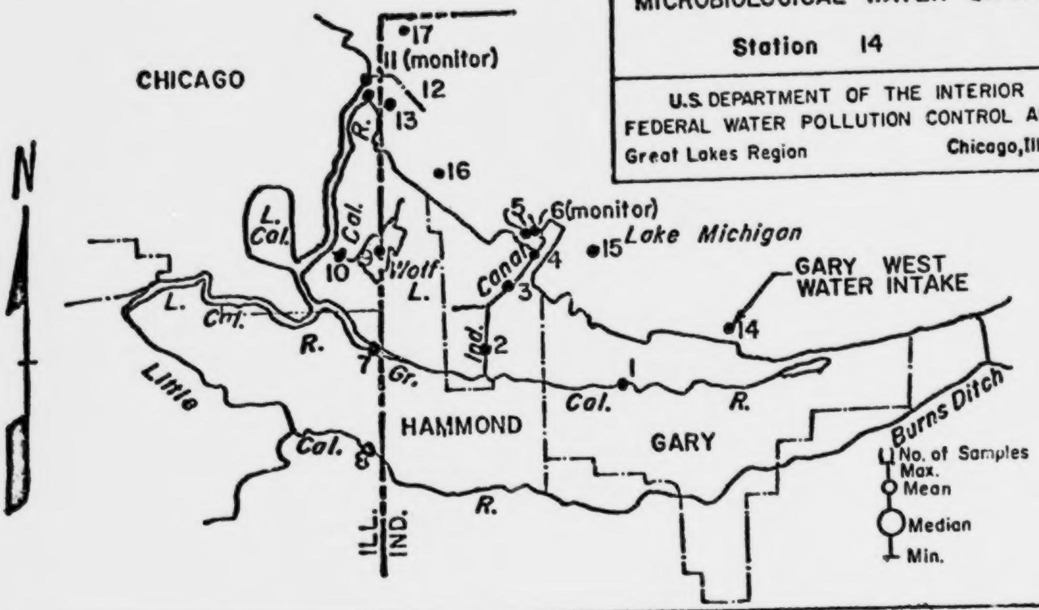

CALUMET AREA SURVEILLANCE PROJECT
LOCATION MAP
Stations 14, 15, 16 & 17
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN.
Great Lakes Region
Chicago, Illinois
STA. 17 - DUNNE CRIB WATER INTAKE (LM 536.4)
STA. 16 - HAMMOND WATER INTAKE (LM 527.2)
STA. 15 - EAST CHICAGO WATER INTAKE (LM 516.9)
STA. 14 - GARY WEST WATER INTAKE (LM 512.2)
Lake Michigan
Calumet Harbor
Wolf Lake
WHITING
EAST CHICAGO
Indiana Harbor Can.
HAMMOND
GARY
CHICAGO
Lake Calumet
Calumet River
Grand Calumet River
Little Calumet River
ILLINOIS
INDIANA

CALUMET AREA SURVEILLANCE PROJECT

MICROBIOLOGICAL WATER QUALITY

Station 14

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN
Great Lakes Region Chicago, Illinois



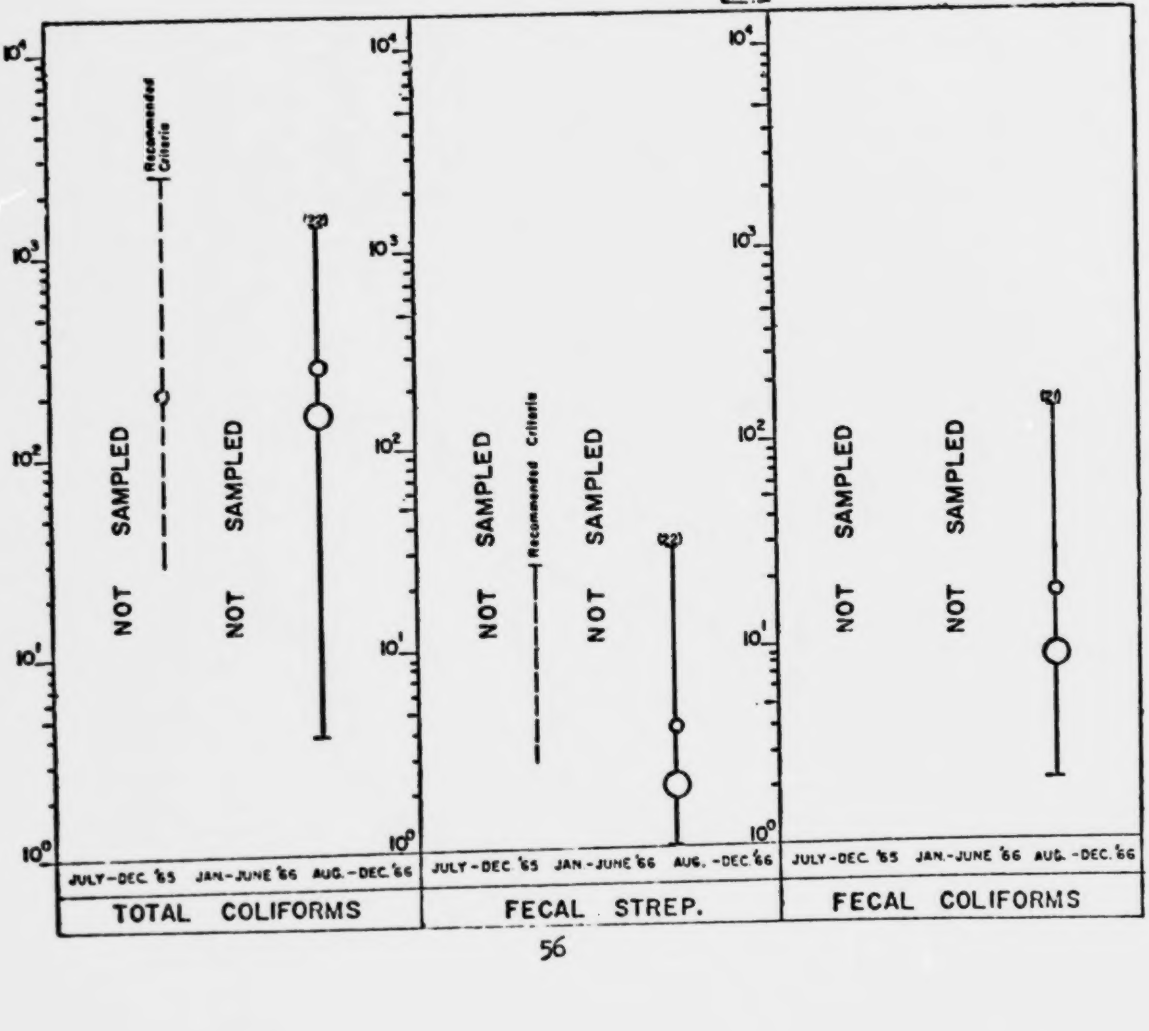


TABLE 14

CHEMICAL QUALITY OF WATER
STATION 14 - GARY WEST WATER FILTRATION INTAKE-LM 512.2

		Recommended Criteria				Aug. 1966-Dec. 1966			
Parameter		Max	Min	Mean	Median	Max	Min	Mean	Median
Water Temp.	°C	29.4				22	1	13.1	13
pH		9.0	7.7		8.1-8.4	8.1	7.1	-	7.7
Conductivity	umho/cm	-	-	-	-	325	260	295	295
Alkalinity	mg/l	-	-	-	-	113	90	103.7	107
DO	"	-	80% sat.	90% sat.	-	14.80	4.9	9.55	9.60
BOD	"	-	-	-	-	2.0	0.1	1.4	1.3
COD	"	-	-	-	-	21	2	10.5	10
Sulphates	"	50		23		37	16	22.9	21
Chlorides	"	15		8		11	8	9.6	10
MBAS	"	0.20		0.05		0.13	0.02	0.06	0.05
NH_3-N)	"	0.05*		0.02*		0.28	0.01	.07	0.06
NO_2+NO_3-N)tot.N	"	0.4*		-		0.54	0.05	0.24	0.22
Org. N)	"					0.46	0.01	0.21	0.21
Sol PO_4	"	-	-	-	-	.05	.01	.035	0.04
Total PO_4	"	0.04*		0.03*		0.24	0.02	.073	0.05
Iron	"	0.30		0.15		3.9	0.05	0.63	0.44
Cyanide	"	0.025				0.01	0.00	0.00	0.00
Sus. Solids	"	-	-	-	-	149	3	21.5	9
Dis. Solids	"	200		162		215	112	168	170
Fluorides	"	1.3		1.0		0.40	0.12	0.21	0.20
Oil & Grease	"	Free from floating oil				4.8	0.0	1.0	0.5
Phenol	ug/l	3.0*		1.0*		5.0	0.00	1.45	1.0
Turbidity	units	No contrast with natural appearance				49	.6	9.7	2.0
Color	"	15		5		20	0	4.45	5.0
Threshold Odor	"	8		4		60	1.5	5.86	2.5

*tentative

Data based on 22 samples

intakes. It became evident that these plants did not have the capacity for this undertaking and therefore the Calumet Area Post Action Surveillance Project began sampling these points during August 1966 in order to determine whether or not the recommended criteria are being met.

The recommended criteria for microbiological parameters have been plotted on the graph "Microbiological Water Quality Station 14," on Page 204. The maximum for total coliforms was not exceeded but the average of 258 per 100 ml was higher than the criteria permit (200 per 100 ml). The criteria for fecal streptococci were met on all but one occasion.

Table 14 compares the recommended criteria for other parameters with the results of the sampling program. The criteria for water temperature, dissolved oxygen, sulphates, chlorides, MBAS, cyanide and fluorides were met.

The water at this point had a pH which was considerably below the range of the criteria. The water was of a high quality and the intake is remote from major sources of pollution so that it should reflect the basic characteristics of "natural" lake waters. The low alkalinity at this point indicates that the recommended range of pH recommended by the criteria cannot be met. It is believed the pH criteria should be reviewed for possible revision.

The results indicate that there was considerably more ammonia nitrogen and total nitrogen present than the tentatively recommended criteria permit. This was also true at Wolf Lake which is another high quality body of water. Ammonia in water is commonly regarded as an indication of local pollution since it is reduced to nitrate and nitrite nitrogen in a relatively short time. But Gary West Water Intake is too remote from man-made pollution for this to be the cause. It is believed that the Gary Water Intake -- as well as Chicago's Dunne Crib Intake, to be discussed later -- normally receive water whose quality is essentially that of the main body of southern Lake Michigan. This in no way alleviates the problem created at water supply intakes when adverse wind and current conditions bring periodic slugs of water containing high concentrations of ammonia nitrogen. It is understood that the Calumet Area Technical Committee is presenting a report which will help to clarify the ammonia nitrogen picture.

There is also considerably more total phosphate than the tentatively recommended criteria permit. The mean concentration of 0.073 mg/l is approximately 2.5 times the tentative criterion of 0.03 mg/l. Data for the four water intake stations reveals that the maximums are usually twice or several times the means.

A severe storm occurred on November 29, 1966. The effect of such a storm on the quality of the water in the lake can be assessed from the results of the November 30, 1966, sampling run. Many of the maximums at this and other water intake stations occurred on this date. Suspended solids and turbidity were very high in comparison to their normal levels. The other maximums give an indication of the composition of the bottom muds which were undoubtedly stirred up. These were organic nitrogen, total phosphate, soluble phosphate and total iron. It is interesting to note that on this date no phenols were found at any of the water intake stations.

Station 15 - East Chicago Water Intake

The East Chicago Water Intake is one of the control points designated by the Calumet Area Technical Committee for inner harbor basins. This intake is located just east of Indiana Harbor and can be severely affected by pollutants from the harbor when the wind is from a westerly direction.

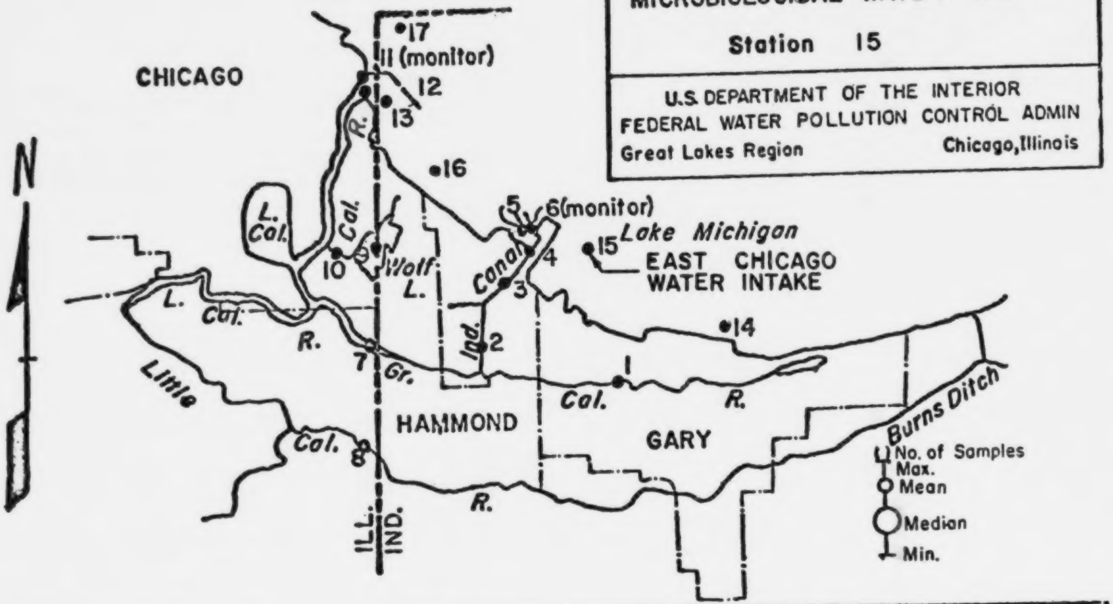
The recommended criteria for inner harbor basins are compared with the actual water quality on the following

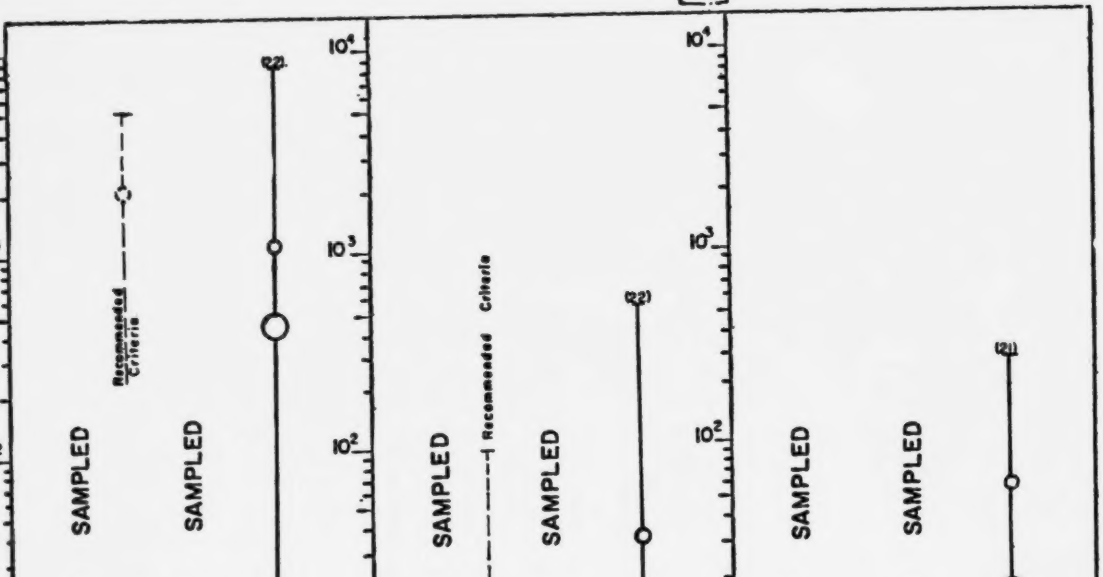
CALUMET AREA SURVEILLANCE PROJECT

MICROBIOLOGICAL WATER QUALITY

Station 15

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN
Great Lakes Region Chicago, Illinois





CALUMET AREA SURVEILLANCE PROJECT

MICROBIOLOGICAL WATER QUALITY

Station 16

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN
Great Lakes Region
Chicago, Illinois

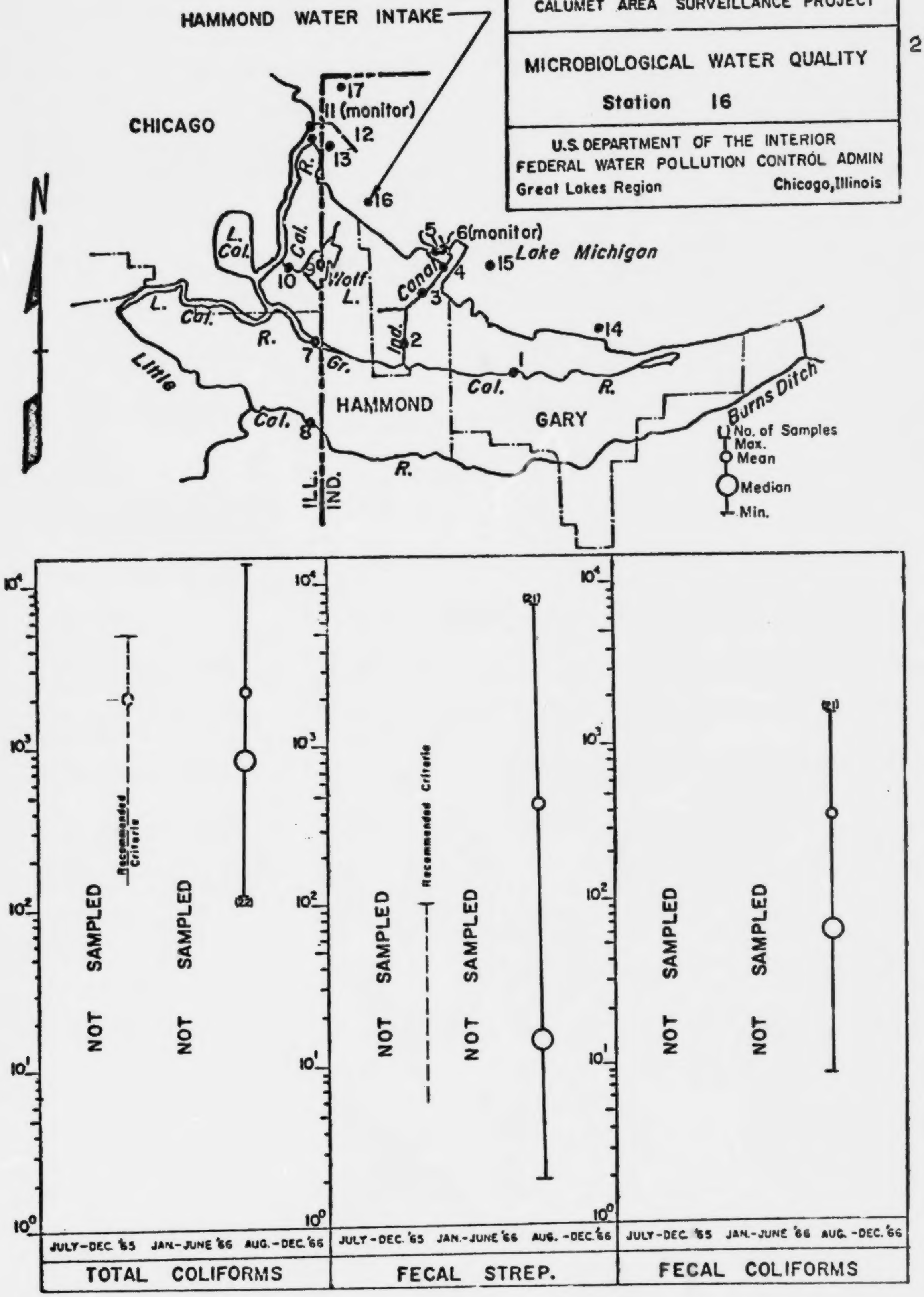


TABLE 15

CHEMICAL QUALITY OF WATER
STATION 15 - EAST CHICAGO WATER FILTRATION INTAKE-LM 516.9

		Recommended Criteria				Aug. 1966-Dec. 1966			
Parameter		Max	Min	Mean	Median	Max	Min	Mean	Median
Water Temp.	°C	29.4				21	0	12.6	13
pH		9.0	7.5		8.0-8.5	8.1	7.4	-	7.7
Conductivity	umho/cm	-	-	-	-	360	275	307	300
Alkalinity	mg/l	-	-	-	-	132	86	103	105
DO	"	-	65% sat.	80% sat.	-	17.05	8.30	12.69	13.00
BOD	"	-	-	-	-	5.5	0.2	1.62	1.6
COD	"	-	-	-	-	62	3	13	11
Sulphates	"	75		35		36	16	24.9	24
Chlorides	"	30		16		13	8	10	10
MBAS	"	0.30		0.10		0.13	0.04	0.07	0.06
NH_3-N	"	0.12*		0.05*		0.40	0.02	0.14	0.14
NO_2+NO_3-N	"	-	-	-	-	0.60	0.00	0.25	0.27
Org. N	"	-	-	-	-	1.19	0.05	0.29	0.21
Sol PO_4	"	-	-	-	-	0.07	0.01	0.04	0.04
Total PO_4	"	0.10*		0.05*		1.00	0.03	0.12	0.06
Iron	"	0.30		0.15		22	0.05	1.48	0.35
Cyanide	"	0.1				0.2	0.00	0.00	0.00
Sus. Solids	"	-	-	-	-	464	2	37	12
Dis. Solids	"	230		187		211	77	164	165
Fluorides	"	1.3		1.0		0.28	0.14	0.20	0.19
Oil & Grease	"	Free from floating oil				4.2	0.0	0.9	0.5
Phenol	ug/l	5.0*		2.0*		7	0	1.5	1
Turbidity	units	No contrast with natural appearance				160	0.6	15	2.0
Color	"	15		5		50	0	7.9	5.0
Threshold Odor	"	20*		8*		100	1.5	14.7	5

*tentative

Data based on 22 samples

TABLE 16

CHEMICAL QUALITY OF WATER
STATION 16 - HAMMOND WATER FILTRATION INTAKE-LM 527.2

Parameter		Recommended Criteria				Aug. 1966-Dec. 1966			
		Max	Min	Mean	Median	Max	Min	Mean	Median
Water Temp.	°C	29.4				22	0	13.0	13
pH		9.0	7.5		8.0-8.5	7.9	7.2	-	7.7
Conductivity	umho/cm	-	-	-	-	320	275	303	300
Alkalinity	mg/l	-	-	-	-	119	88	102.7	103
DO	"	-	65% sat.	80% sat.	-	13.35	5.70	9.48	9.30
BOD	"	-	-	-	-	3.6	0.9	1.72	1.6
COD	"	-	-	-	-	32	4	13.4	12
Sulphates	"	75		35		38	13	24.9	25
Chlorides	"	30		16		13	9	10.3	10
MBAS	"	0.30		0.10		0.12	0.03	0.07	0.07
NH_3-N	"	0.12*		0.05*		0.38	0.04	0.18	0.16
NO_2+NO_3-N	"	-	-	-	-	0.76	0.05	0.32	0.26
Org. N	"	-	-	-	-	0.73	0.06	0.29	0.26
Sol PO_4	"	-	-	-	-	0.06	0.01	0.04	0.04
Total PO_4	"	0.10*		0.05*		0.32	0.03	0.10	0.07
Iron	"	0.30		0.15		5.9	0.04	0.85	0.52
Cyanide	"	0.1				0.01	0.00	0.00	0.00
Sus. Solids	"	-	-	-	-	202	2	30.6	13
Dis. Solids	"	230		187		275	87	167	170
Fluorides	"	1.3		1.0		0.24	0.16	0.20	0.20
Oil & Grease	"	Free from floating oil				5.4	0.0	0.8	0.4
Phenol	ug/l	5.0*		2.0*		6	0	2.1	2
Turbidity	units	No contrast with natural appearance				180	0.6	17.6	2.8
Color	"	15		5		15	0	4.6	4
Threshold Odor	"	20*		8*		150	3.5	34	16

*tentative

Data based on 22 samples

pages. The criteria for water temperature, dissolved oxygen, sulphates, chlorides, MBAS, dissolved solids and fluorides were met during July-December 1966.

The pH of the water was outside the range of the criteria; being considerably lower than the minimum limit set (see previous discussion of pH criteria). A similar situation exists at all four water intake stations.

This station was most severely affected by the storm that took place on November 29, 1966. November 30, 1966, was one of the two days on which the criteria for total coliforms was not met. The fecal streptococci count was 540 per 100 ml, much higher than the next highest count of 100 per 100 ml, which occurred during the next week. The normal fecal streptococci count at this station was less than 5 per 100 ml. This suggests that the lake bottom in this area contained a considerable amount of man-made sediment. Many of the maximums at this station were a result of the storm. Concentration of BOD, COD, organic nitrogen, total phosphate, total iron, turbidity, and suspended solids were highest on November 30. Total iron, turbidity and suspended solids were far above their normal levels and the data for subsequent weeks indicate that the lake did not return to normal for more than a month. This indicates that there is a considerable "bank" of material at the bottom of thelake which can be stirred up by violent weather.

Station 16 - Hammond Water Intake

The Hammond Water Intake is the other control point designated by the Calumet Area Technical Committee for inner harbor basins. This intake is located west of Indiana Harbor and is often affected by wastes from the harbor, especially when the wind is from the south or the east.

This is the only water intake station where the microbiological criteria were seriously violated. The total coliform count was considerably above the maximum of 5000 per 100 ml on two occasions and the fecal streptococci count was above 100 per 100 ml on three occasions.

The criteria for water temperature, dissolved oxygen, sulphates, chlorides, MBAS, cyanide, fluorides and color were met. As at the other water intake stations the criteria for pH and ammonia were not met. The criteria for total phosphate, iron, dissolved solids, phenols and threshold odor were not met.

The effect of a major storm stirring up the lake bottom is reflected by the data for November 30, 1966. Organic nitrogen, total phosphate, total iron, turbidity and suspended solids were all highest on this date.

Station 17 - Dunne Crib Water Intake

The Dunne Crib Water Intake, which supplies lake water to the city of Chicago's South District Water Filtration Plant, is the second control point designated by the Calumet Area Technical Committee for open lake water. This intake is well isolated from man-made sources of pollution. Its location outside of the Calumet Harbor breakwater shields it from pollution originating in Indiana Harbor. The water quality at this point is better than it is at any of the other water intake stations.

The criteria for water temperature, dissolved oxygen, sulphates, chlorides, MBAS, cyanide, dissolved solids, fluorides, phenol and color were met at this station. The criteria for pH, ammonia nitrogen and threshold odor were not met.

The criteria for total phosphate and total iron were met except during and after the storm that took place on November 29, 1966. Before this storm the levels of both parameters were low enough to satisfy the criteria.

CALUMET AREA SURVEILLANCE PROJECT

MICROBIOLOGICAL WATER QUALITY

Station 17

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN
Great Lakes Region Chicago, Illinois

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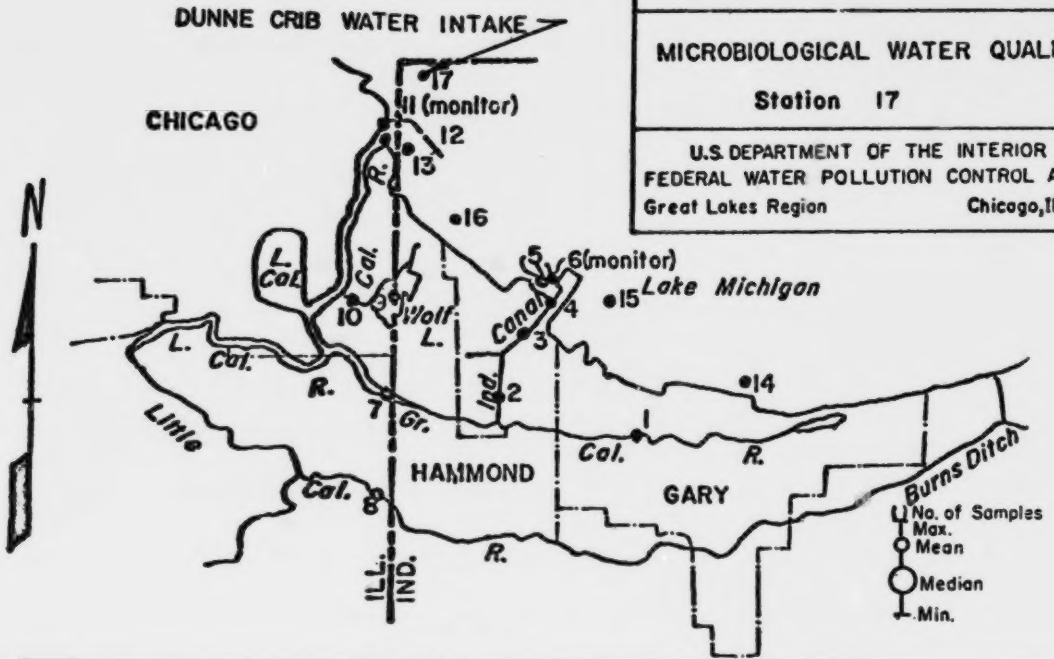


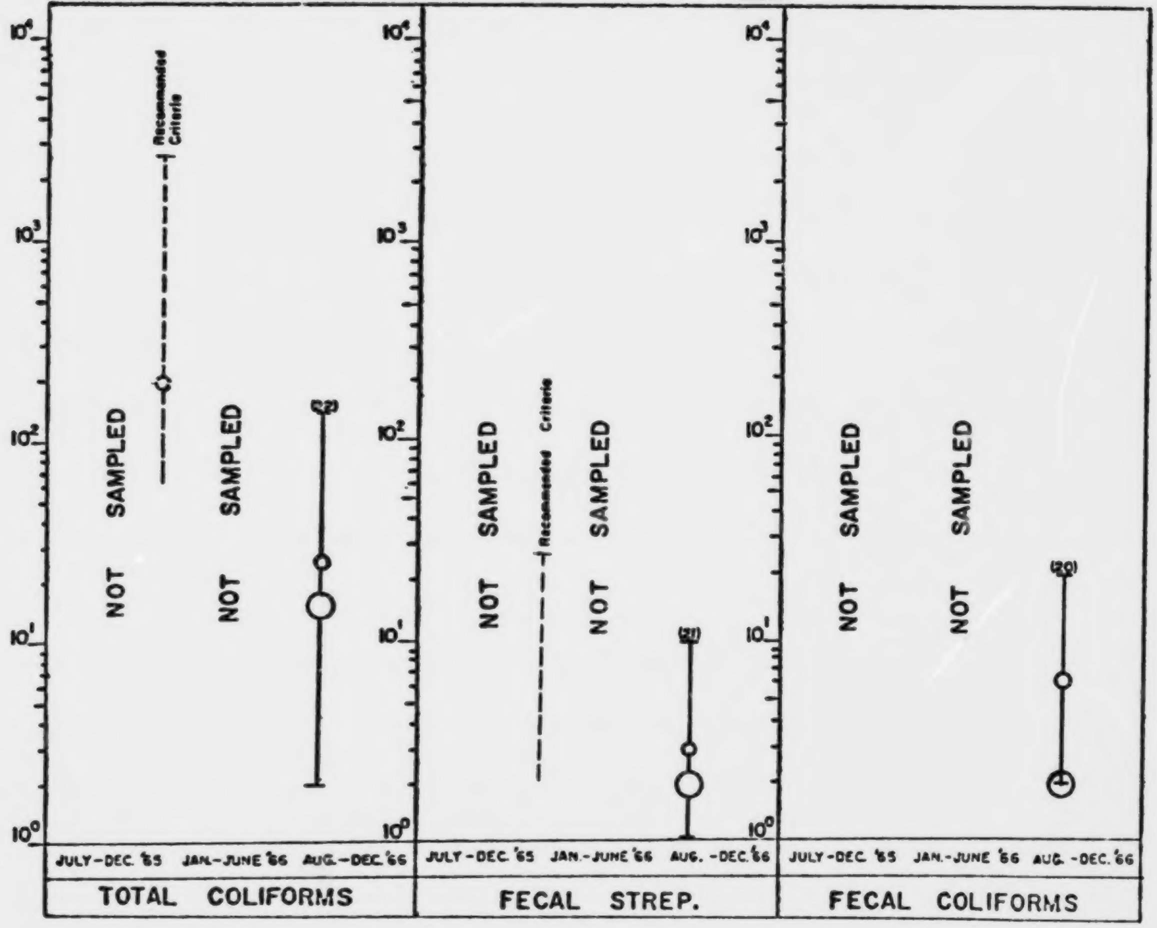


TABLE 17

CHEMICAL QUALITY OF WATER
STATION 17 - SOUTH DISTRICT DUNNE CRIB WATER FILTRATION INTAKE-LM 536.4

		Recommended Criteria				Aug. 1966-Dec. 1966			
Parameter		Max	Min	Mean	Median	Max	Min	Mean	Median
Water Temp.	°C	29.4				23	3	14.7	15
pH		9.0	7.7		8.1-8.4	8.1	7.6	-	7.8
Conductivity	umho/cm	-	-	-	-	330	260	292	290
Alkalinity	mg/l	-	-	-	-	114	88	103	104
DO	"	-	80% sat.	90% sat.	-	16.30	6.05	12.17	13.20
BOD	"	-	-	-	-	1.6	0.2	0.91	1.0
COD	"	-	-	-	-	18	2	9.6	8
Sulphates	"	50		23		32	13	22	23
Chlorides	"	15		8		12	8	9.3	9
MBAS	"	0.20		0.05		0.12	0.02	0.05	0.05
NH_3-N)	"	0.05*		0.02*		0.23	0.01	0.07	0.05
NO_2+NO_3-N)tot.N	"	0.4*				0.67	0.05	0.22	0.20
Org. N	"					0.33	0.02	0.19	0.20
Sol PO_4	"	-	-	-	-	0.06	0.01	0.03	0.03
Total PO_4	"	0.04*		0.03*		0.21	0.02	0.06	0.05
Iron	"	0.30		0.15		3.9	0.01	0.47	0.19
Cyanide	"	0.025				0.01	0.00	0.00	0.00
Sus. Solids	"	-	-	-	-	135	1	17.3	7
Dis. Solids	"	200		162		196	37	157	160
Fluorides	"	1.3		1.0		0.30	0.16	0.20	0.20
Oil & Grease	"	Free from floating oil				6.7	0.0	0.9	0.7
Phenol	ug/l	3.0*		1.0*		3	0	0.6	0
Turbidity	units	No contrast with natural appearance				160	0.6	13.0	2.7
Color	"	15		5		10	0	3.6	3
Threshold Odor	"	8		4		35	2.5	8.3	6

*tentative

Data based on 22 samples

The microbiological quality of the water was very good. The counts for total coliform and fecal streptococci were well within the recommended criteria.

BIOLOGICAL QUALITY

Biological field surveys have been made in the Calumet area to assess any biological changes that may take place. Surveys were made during May 17-19, 1965, and during July 20-25, 1966.

The biological condition of the Calumet area was severely degraded. Pollution-intolerant organisms were not found at any location in 1966, whereas previously some did populate Mile Point LC 334.9 (Station 8) on the Little Calumet River.

The Calumet River from its confluence with the Grand Calumet River to the Calumet Harbor was severely degraded. Sludgeworms were the only organisms present. Calumet Harbor bottom sediments contained fingernail clams, but only a few were living. Sludgeworms were the only organisms found in the Grand Calumet River.

The bottom sediments of the Indiana Harbor Canal consisted of rock, rubble, petroleum wastes, and a black oily organic ooze. Sludgeworms were the only benthic fauna observed. Oil slicks covered the surface.

The attached table is a comparison of field observations. The first line of data for each station represents the 1965 data and the second line the 1966 data. The major differences in water conditions between the two surveys were temperature and pH. The benthic fauna were similar, with only the very pollution-tolerant organisms being found. The differences noted could be attributed to the later season at which the samples were taken.

There was no significant improvement in water quality indicated by the biological field observations.

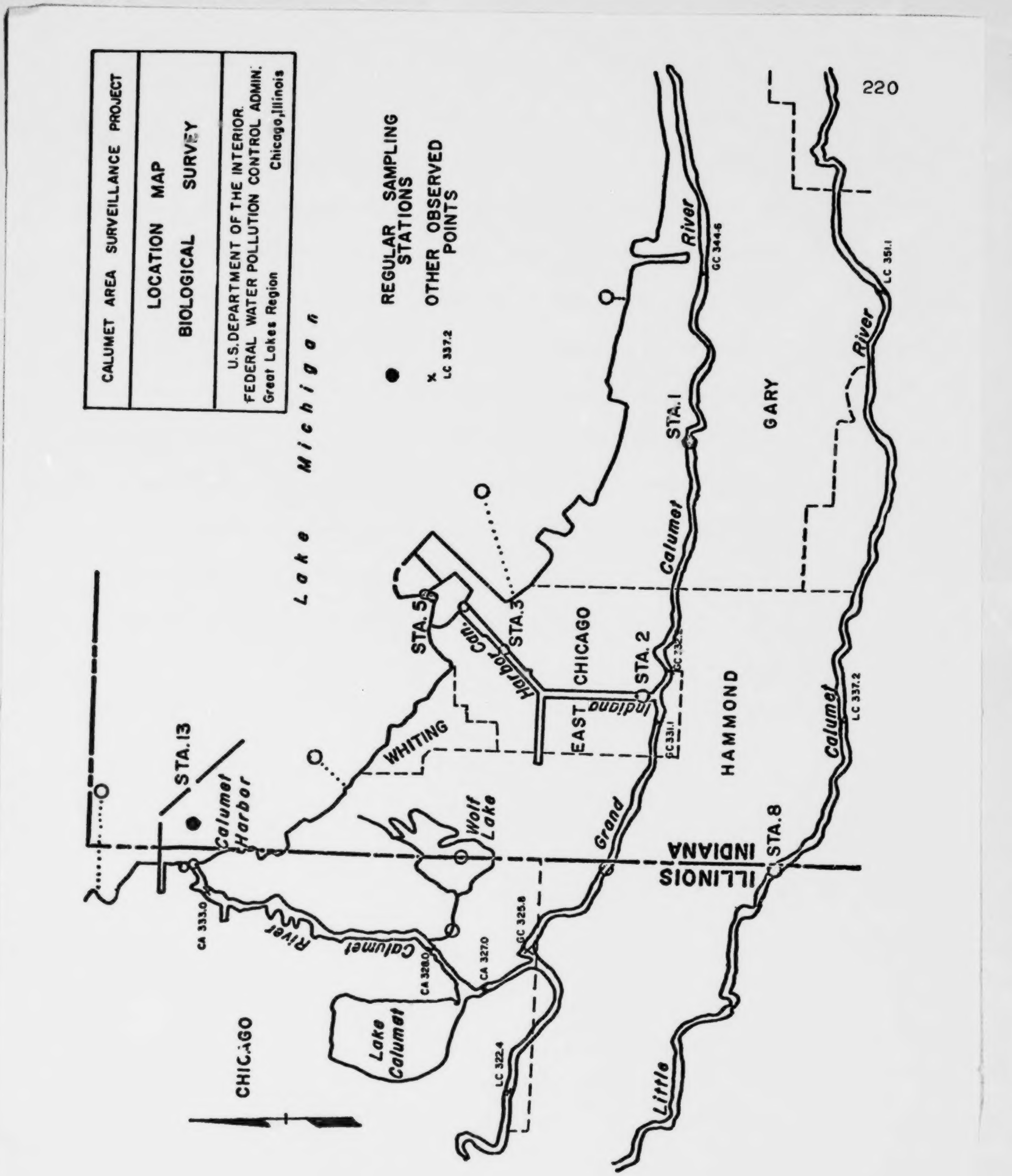

CALUMET AREA SURVEILLANCE PROJECT
LOCATION MAP
BIOLOGICAL SURVEY
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN.
Great Lakes Region
Chicago, Illinois
● REGULAR SAMPLING STATIONS
× LC 337.2 OTHER OBSERVED POINTS
Lake Michigan
CHICAGO
Lake Calumet
Calumet River
Calumet Harbor
STA. 13
Wolf Lake
WHITING
EAST CHICAGO
Indiana Harbor Can.
STA. 5
STA. 3
STA. 2
STA. 1
STA. 8
HAMMOND
GARY
Grand Calumet River
Little Calumet River
ILLINOIS
INDIANA
CA 333.0
CA 328.0
CA 327.0
GC 325.8
LC 322.4
GC 331.1
GC 332.5
GC 344.6
LC 337.2
LC 351.1

TABLE 18 - CALUMET AREA BIOLOGICAL SURVEY

	WATER								BOTTOM			
Station Number	Seechi Depth m	Temp. C°	D.O. mg/1	% Sat.	Depth M	Odor	pH	Time	Type	Odor	Temp. C°	Predom. Org.
1	.25	21.3	5.4	62	1.5	Petro	7.30	12:00	Ooze	Sewage	21.3	None noticed
	<.10	32	2.0	25	1.1	Petro	6.9	12:00	Silt Sand	Petro	32	" "
2	.25	22	3.0	36	1.0	Sewage	7.05	13:15	Ooze Silt	Sewage Petro	22.0	" "
	<.25	32.0	1.6	21	2.0	Petro	7.0	13:05	Rock Gravel	Petro	32.0	Sludgeworms
3	.3	21.5	3.0	34	7.0	Petro	8.65		Ooze	Sewage Petro	21.5	None noticed
	1.5	31.0	3.5	45	9.0	Petro	6.9	11:15	Ooze Silt	Petro	24.0	" "
5	.75	17.0	5.4	58	10.0	Sewage Petro	8.0		Ooze	Sewage Petro	17.0	Sludgeworms
	1.5	29.0	4.2	53	12.0	Normal	7.0	12:30	Clay	Normal		Sludgeworms
8	.2	19.0	8.8	100	.30	Sewage	8.20	15:00	Sand Detri.		19.0	Bloodworms Mayflies Sludgeworms
	<.25	20.0	4.2	46	<.25	Sewage	7.6	10:50	Sand Gravel	Sewage	20	Snails Bloodworms
13	2.5	16.0	8.9	93	10.5	Normal	8.2		Silt	Normal	13.0	Fingernail clams
	1.0	23.0	8.0	94	8.0	Normal	7.4	14:00	Gravel Sand	Normal	22.0	" " Sludgeworms

R. J. Bowden

ADDENDUM

REPORT ON CALUMET HARBOR MONITOR INSTALLATION

On September 2, 1966, an automatic water quality monitoring station was installed in the north pierhead light structure at the mouth of the Calumet River. The purpose of this station is to monitor the quality of water entering the Calumet River from Calumet Harbor. At present the parameters being monitored are pH, water temperature, dissolved oxygen and conductivity. In the future it is planned to monitor sulphates and ferric iron in order to determine more directly the effect of wastes from the United States Steel Corporation, South Works, which are discharged to the harbor. Parametric systems for these parameters, along with an automatic sample taker, are being developed and will be installed when they become available. The automatic water sampler will collect a sample when a parameter exceeds a preset limit. These samples will be returned to the laboratory for a more complete analysis.

The installation and operation of this facility presented several unique problems. The only power available was 440 volt, 25 cycle, furnished by the United States Steel

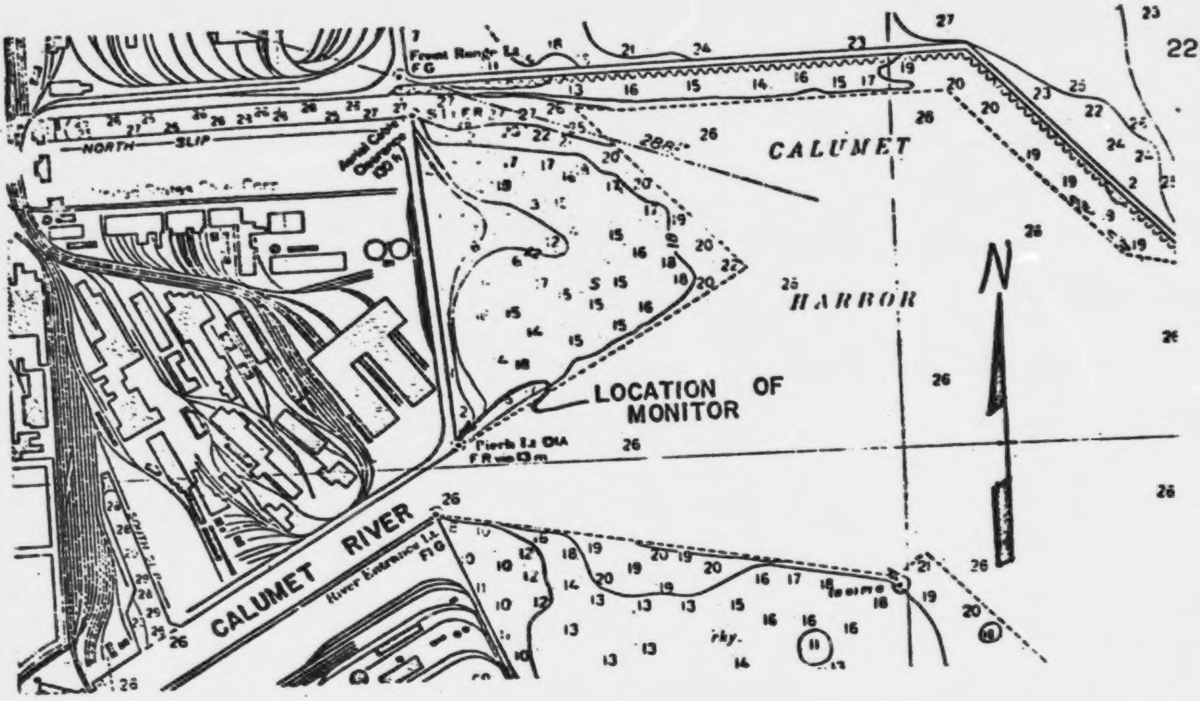
Corporation. This was converted to 120 volt, 60 cycle, by a motor generator set which was installed in the structure. The motor generator also provides heat which eliminates the need for a heater during the winter but overheats the structure during the summer. The summer temperature is controlled by a forced air fan operated by a thermostat set to turn the fan on when the inside temperature reaches 80°F. The fan entirely replaces the air every two minutes. This system has kept the ambient temperature within the range specified for operation of the monitor.

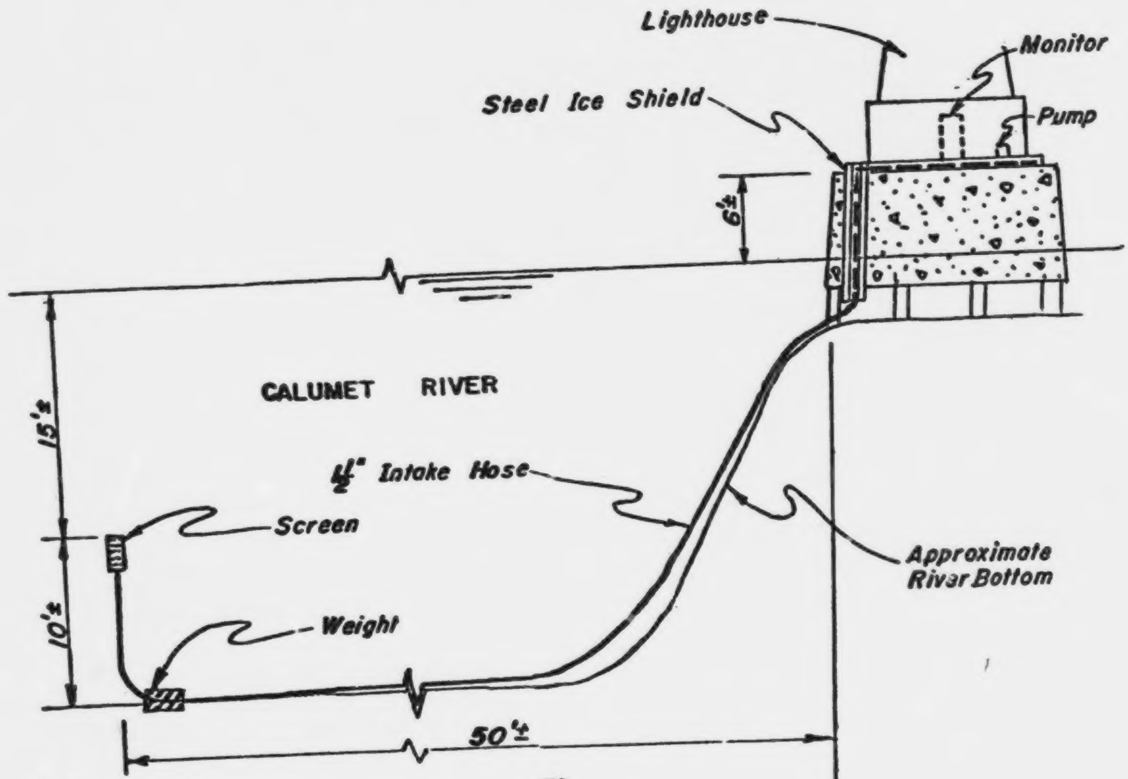
In order to get a representative sample it was necessary to locate the intake some distance out in the channel. The Calumet River at this point is heavily used by shipping of all types. It was recognized that any intake not located on the bottom would be struck by vessels. Since sampling on the bottom is not satisfactory, the normal submersible pump installation could not be used. The intake consists of a screen supported by floats on the end of a flexible hose which is anchored to the bottom. The floats keep the screen approximately 10 feet off the bottom and 15 feet below the surface. If a vessel hits the screen it will simply push it down and do little or no damage. The pump is a 1/2 HP centrifugal suction pump which is located in the structure with the monitor.

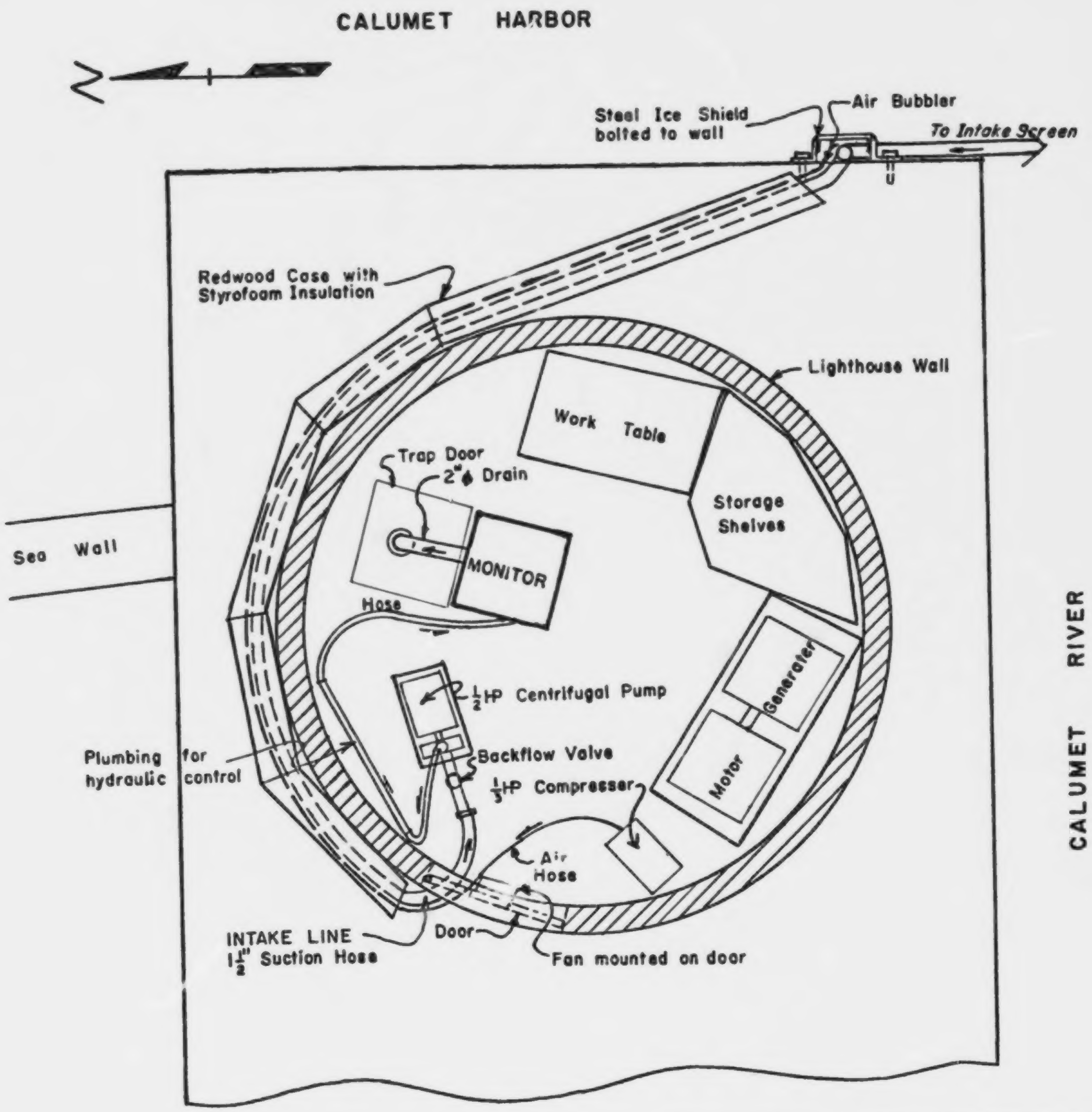
R. J. Bowden

During the winter large piles of ice form against the side of the light structure along which the intake hose runs. In order to protect the hose a heavy steel member consisting of two 6" x 6" x 3/4" angles welded to a 10" channel was bolted to the wall and encloses the hose where it is exposed to the ice. In order to keep ice from forming inside the steel an air line with a 1/3 HP compressor continuously bubbles air inside the steel during the winter months. All exposed portions of the intake line are encased in redwood and insulated with styrofoam.

The monitor drains into a well located beneath the light structure. The discharge from the monitor was sufficient to cause the well to fill up and eventually flood the structure. Therefore, a sump pump was installed in the well which drains it when the water reaches a certain level.


NORTH SLIP
CALUMET
HARBOR
N
LOCATION OF MONITOR
CALUMET RIVER


Lighthouse
Monitor
Steel Ice Shield
Pump
6'±
CALUMET RIVER
15'±
1½" Intake Hose
Screen
Approximate River Bottom
10'±
Weight
50'±



SCALE: 1" = 3'-0"

CALUMET AREA SURVEILLANCE PROJECT

PLAN OF CALUMET
MONITOR INSTALLATION

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN.
Great Lakes Region Chicago, Illinois

MR. STEIN: Thank you.

Are there any comments or questions?

(No response.)

MR. STEIN: One clarification. What do you mean by "an order of magnitude"?

MR. BOWDEN: An order of magnitude is one decimal place. The reduction of an order of magnitude would be --

MR. STEIN: Ten times?

MR. BOWDEN: Ten times. That is correct.

MR. STEIN: In other words, in the part where you talk about bacterial counts being approximately one order of magnitude lower during 1966 than during 1965, that ten times is a significant decrease?

MR. BOWDEN: Yes.

MR. STEIN: Are there any other comments or questions?

(No response.)

MR. STEIN: If not, thank you, Mr. Bowden.

MR. POSTON: We also have Mr. Dwight Ballinger here, substituting for Mr. Kittrell, because of his illness, who is Chairman of the Technical Committee. He will give us a brief report of the Technical Committee.

MR. STEIN: Just one moment, please.

Mr. Bowden, will you come back? I think Mr.

Klassen has a question.

MR. KLASSEN: Mr. Bowden, let me refer you to the last sentence on Page 3:

> "The waters at Gary-Hobart and Dunne Crib are of high quality and meet the criteria except for ammonia nitrogen."

Does this ammonia nitrogen pertain to Gary-Hobart and Dunne Crib, or just the one?

MR. BOWDEN: Yes, the criteria for ammonia nitrogen are not met at any of the lake intakes.

MR. STEIN: While you are back, and as long as we are doing this, I don't know that this is really clear here.

When you talk about the western portion of the Grand Calumet River being improved between July and November of 1966, and then refer to the fact that it went up in December, do you mean it is up from December until the present, or just during December?

MR. BOWDEN: The condition of the waters at present is the same as it was in December. In other words, it is seriously polluted. It is at the same level as it was last year.

MR. STEIN: Do you have any notion as to why that has happened, first a decrease and then an increase?

MR. BOWDEN: It is purely conjecture on my part, but it is probably due to the winter cessation of chlorination, or to the discharge of lagoons into the stream during December 1966.

MR. STEIN: Mr. Poole?

MR. POOLE: I can't clarify it, Mr. Chairman, but maybe Mr. Miller can. There is sewage getting away from the Hammond Sanitary District. This would be my guess. There are no lagoons. The Hammond chlorination facilities are just about ready for operation, but are not in yet.

Do you know of anything unusual that may have started in December?

MR. MILLER: The only thing I would know would be storm overflows during this period, which would be the Calumet West, just a storm overflow by the sewer system.

MR. STEIN: I think if this is a pattern and if that is significant, we really should try to be able to figure out the cause of this.

Mr. Klassen?

MR. KLASSEN: I have one other question, and it is similar to my other question.

I refer to Paragraph No. 7 on Page 5. You say the water quality does not meet the recommended criteria, referring to ammonia and pH. Does the pH pertain also to the Dunne Crib or just to the Gary West?

MR. BOWDEN: No. The pH pertains to all four water quality intakes.

MR. KLASSEN: You mean it does not? Is it above or below the range here? Could you tell us?

MR. BOWDEN: The pH criteria for annual median is somewhat below the criteria range. However, it is within the range for daily median. The range for annual median is somewhat below.

MR. POSTON: This is one of the things that we have been looking into, as to what the significance of this means. We have been looking into both the change of the quality in the stream suddenly in December, and exactly what the change in pH means.

The pH in itself isn't a bad level, but the fact that it did change indicates that something is happening here that needs further investigation if we are to fully understand the problem.

Is that about right?

MR. BOWDEN: Yes, sir.

MR. STEIN: All right. Thank you, Mr. Bowden.

MR. BOWDEN: Thank you, Mr. Stein.

MR. STEIN: Before the next man speaks, I would like to indicate that what we are seeing here in this type of surveillance to the best of my knowledge is not prevalent in many other parts of the country. I think in order to protect water quality intakes.

MR. KLASSEN: You mean it does not? Is it above or below the range here? Could you tell us?

MR. BOWDEN: The pH criteria for annual median is somewhat below the criteria range. However, it is within the range for daily median. The range for annual median is somewhat below.

MR. POSTON: This is one of the things that we have been looking into, as to what the significance of this means. We have been looking into both the change of the quality in the stream suddenly in December, and exactly what the change in pH means.

The pH in itself isn't a bad level, but the fact that it did change indicates that something is happening here that needs further investigation if we are to fully understand the problem.

Is that about right?

MR. BOWDEN: Yes, sir.

MR. STEIN: All right. Thank you, Mr. Bowden.

MR. BOWDEN: Thank you, Mr. Stein.

MR. STEIN: Before the next man speaks, I would like to indicate that what we are seeing here in this type of surveillance to the best of my knowledge is not prevalent in many other parts of the country. I think in order to protect the waters here, we are going through the kind of checks that have not been too frequent on a continuing basis here, and, of course, as the reports come in, we are dealing with this raw data that have to be evaluated. I think the kind of protection that this approach and the scrutiny is providing is probably as tight and as careful as we have anywhere in the country on water pollution control.

I want you to understand this: This is probably a pioneer in this respect. Because the water resource is that valuable and that important, we just have to do it, but I think that should be taken in perspective.

MR. POSTON: Mr. Chairman, there is one thing that occurred to me. That is, with reference to the pH of 7.7 which didn't quite meet the standards, many, many places around the country would be very happy to have this kind of water, but this is not typical of the water in Lake Michigan and we want to maintain water quality in Lake Michigan at the high level that it is now. Any change that we see has significance. Even if it in itself is not bad, it is a an index of change taking place, and we want to look into this very carefully.

MR. STEIN: Mr. Ballinger?

STATEMENT OF DWIGHT G. BALLINGER, SUPERVISORY CHEMIST, CONSULTANT TO TECHNICAL COMMITTEE, FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, DEPARTMENT OF THE INTERIOR, CINCINNATI, OHIO

MR. BALLINGER: Mr. Chairman, Conferees, Ladies and Gentlemen:

I am Dwight Ballinger, Supervisory Chemist, Federal Water Pollution Control Administration, Cincinnati, Ohio.

The Laboratory Directors of the Calumet Area-Lake Michigan Enforcement Conference have completed a study of the precision and accuracy of methods of analysis of ammonia nitrogen in Lake Michigan waters. The report is herewith submitted.

MR. STEIN: This report, without objection, will be entered into the record as if read.

Do you have all the Laboratory Directors listed in this report?

MR. BALLINGER: No, sir, I don't believe so.

MR. STEIN: I think we should have these for the record, if this is a report of the Laboratory Directors.

MR. BALLINGER: Perhaps Mr. Scarce can supply that information.

MR. SCARCE: Yes, I can. The Laboratory Directors are as follows:

American Oil - Robert Austin

Cities Service Oil Co. - George Jackson

City of Chicago, Bureau of Water - Carleton Duke

Gary-Hobart Water Corp. - Herb Plowman

Great Lakes-Illinois River Basin Project -
L. E. Scarce (chairman)

Indiana State Board of Health - Steven Kin

Inland Steel Co. - Thomas Voges

Lake Huron Program Office, GLIRBP - Ralph Christianson

Lake Ontario Program Office, GLIRBP - William Fisher

Metropolitan Sanitary District of Metro Chicago -
Alfred Tenney

Robert A. Taft Sanitary Engineering Center -
Dwight Ballinger.

MR. STEIN: Thank you.

D. G. Ballinger

(The following report was submitted by Dwight G. Ballinger:

REPORT TO
THE TECHNICAL COMMITTEE
OF THE CALUMET AREA-LAKE MICHIGAN
ENFORCEMENT CONFERENCE

ON

A STUDY OF PRECISION AND ACCURACY OF LABORATORIES AND METHODS OF ANALYSIS OF AMMONIA NITROGEN IN LAKE MICHIGAN WATERS

BY

THE LABORATORY DIRECTORS OF THE
CALUMET AREA-LAKE MICHIGAN
ENFORCEMENT CONFERENCE

JANUARY, 1967

UNITED STATES DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
GREAT LAKES-ILLINOIS RIVER BASINS PROJECT
CHICAGO, ILLINOIS

D. G. Ballinger

A STUDY OF PRECISION AND ACCURACY OF LABORATORIES AND METHODS OF ANALYSIS OF AMMONIA NITROGEN IN LAKE MICHIGAN WATERS

A Report to the Technical Committee of the Calumet Area-
Lake Michigan Enforcement Conference

by

The Laboratory Directors of the Calumet Area-Lake Michigan
Enforcement Conference

I. INTRODUCTION

This is a report of comparison studies performed by cooperating laboratories concerned with analysis of Lake Michigan waters and stream waters in the Calumet Area of Indiana and Illinois.

A series of comparison studies is to be made for determinations of ammonia nitrogen, phosphate, phenol, cyanide, and threshold odor. Part I presents the findings from a series of five comparison studies on ammonia nitrogen completed between September 9, 1965, and April 26, 1966.

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The objectives of the comparison studies are:

1. To determine the reliability (precision and accuracy) of the analytical procedures as normally used in the desired concentration range.

2. To determine if there is a change in the accuracy of these procedures arising from departures from prescribed analytical routine.

3. To determine the degree of variation between the participating laboratories.

4. To find the sensitivity of the methods as used.

5. To recommend necessary changes in procedures.

The laboratories participating in the ammonia nitrogen study were:

1. American Oil Company
2. Cities Service Oil Company
3. City of Chicago, Bureau of Water, Dept. of Water and Sewers
4. Gary-Hobart Water Corporation
5. Great Lakes-Illinois River Basins Project
6. Indiana State Board of Health
7. Inland Steel Company
8. Lake Huron Program Office, GLIRBP

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9. Lake Ontario Program Office, GLIRBP
10. Metropolitan Sanitary District of Greater Chicago
11. Robert A. Taft Sanitary Engineering Center

II. PROCEDURES. CHRONOLOGICAL DEVELOPMENT

This section of our report presents a brief chronological commentary on the conditions, implied and explicit, which obtained in the various Test Series. It is intended to provide background for assessment of the results obtained in individual Series and also for comparison of any or all Series. All results, excepting those of Series I, are summarized in Tables 1 to 6 in the Appendix.

SERIES I. September 9, 1965

Number of samples analyzed: Four: Raw Lake Water, preserved and unpreserved, from Gary-Hobart and from Chicago South District Filtration Plant.

Conditions: Samples stored at room temperature 24 hours.

Participating laboratories:

1. City of Chicago, Bureau of Water, Dept. of Water and Sewers

2. Gary-Hobart Water Corporation
3. Great Lakes-Illinois River Basins Project
4. Metropolitan Sanitary District of Greater Chicago

There was no direct stipulation of the method to be used in this Series. As it turned out, of the four participating laboratories, no two used the same method. The results, as reported, were widely divergent. Average values from the four participating laboratories are shown below in mg/1.

Chicago -- SDFP		Gary-Hobart	
Unpreserved	Preserved	Unpreserved	Preserved
0.024	0.082	0.026	0.110
0.160	0.200	0.150	0.260
0.05	0.09	0.06	0.06
0.01	0.02	0.01	0.02

These results revealed that the laboratories were consistent within their own methods, but no two laboratories agreed as to the concentration of ammonia found.

Because of the wide disagreement, the Technical Committee, Calumet Area-Lake Michigan Enforcement Conference, requested that comparison studies be made by laboratories concerned with Calumet Area surveillance. The GLIRBP laboratory prepared a working draft of the proposed comparison studies. These were distributed to the Laboratory Directors for review.

September 30, 1965

A meeting of the Calumet Area Laboratory Directors, under the chairmanship of Mr. Clifford Risley, Jr., was held to discuss and revise the proposed procedures for future comparison studies. The members of the Technical Committee of the Calumet Area-Lake Michigan Enforcement Conference met with the Laboratory Directors during the first hour to review the problem and offer their suggestions.

The Laboratory Directors agreed that Series II should consist of ammonia nitrogen, phosphate, phenols, cyanide, and odor standards and samples.

SERIES II. October 13, 1965

Number of samples for ammonia nitrogen:

Nine (5 synthetic)
(4 raw water)

Additionally: phosphates - 10 samples
phenols - 5 "
cyanide - 8 "
odor - 5 "

Participating laboratories:

1. American Oil Company
2. City of Chicago, Bureau of Water, Dept. of Water and Sewers
3. Gary-Hobart Water Corporation
4. Great Lakes-Illinois River Basins Project
5. Indiana State Board of Health
6. Inland Steel Company
7. Metropolitan Sanitary District of Greater Chicago

Analysis date: raw water 10/13/65; synthetic 10/14/65.

Conditions: Collection, preservation, and distribution procedures were standardized and time for analyses synchronized. Forms were distributed for reporting results in triplicate, wherever practicable. Deviations from the above were to be duly recorded on the report forms.

Conditions were stipulated for distillation procedure as follows: The distillation method should be followed as described in Standard Methods for the Examination of Water and Wastewater, 11th Edition, Pages 168-173 (1), with emphasis on the following points:

"1. The distillation apparatus should be steamed out by placing 500 ml of distilled water and 10 ml of phosphate buffer solution in the flask; steam out until the distillate is free of ammonia.

2. Preserved samples and standards should be adjusted to a pH of seven, using a pH meter prior to adding the buffer solution.

3. Use a 500 ml sample of standard and distill over approximately 250 ml, collecting the distillate in 0.002N sulfuric acid. The distillate is then concentrated by evaporation on a hot plate. The resulting solution should be made up to 100 ml and nesslerized. This gives a concentration factor of 5. Standards 4 and 5 need not be concentrated by evaporation.

4. The method used to read the sample will be indicated on the report."

The Sodium Phenate method was also outlined for the Technicon AutoAnalyzer.(2) However, the final paragraph of these instructions read as follows: "Any method or methods that are being used by any of the laboratories may be employed in these analyses. The method used should be spelled out for the purpose of interpreting the results."

At the November 29 meeting of the Laboratory Directors, the following points were made in discussing the results of the last comparison, Series II. Considerable variation existed among the laboratories both in their procedure and in the results reported. Each laboratory, however, displayed good reproducibility within itself. Values obtained by the Technicon method were judged best, followed in order by distillation and direct nesslerization. The following excerpts from the November 29 meeting are pertinent at this point:

> "1. It appears that some of the laboratories were not experienced at running analyses in the low range (0.00-0.06 mg/l) desired and/or by the prescribed methods. It also appears that too much pressure was placed on the laboratories to accomplish a large amount of work in a short period of time. It was recommended that the study be conducted again, at a more relaxed pace, and with a fixed number of samples and standards for each run.
>
> "2. An indispensable condition for conducting a successful inter-laboratory study is skill and familiarity with the method on the part of all

"participants. The methods used, when applied to the low concentrations found in lake water, i.e. at or near the maximum sensitivity of the method, cannot be used successfully without a great deal of skill and familiarity with the method on the part of the individual analyst. This was not the case in this series of comparison studies.

"3. Identical copies of a detailed description of all steps to be followed in this test procedure for comparison studies should be provided to each participant.

"4. One standard sample, plus a sample of Gary raw water and Chicago raw water, is enough for each laboratory to check at one time.

"5. Although one laboratory used research quality instrumentation, the Spectronic 20 is considered to be good enough to give the desired results."

Under the chairmanship of Mr. LeRoy Scarce, the Laboratory Directors met February 17, 1966. Here it was decided that future studies would be limited to one parameter at a time. Ammonia nitrogen was selected for the next test series using standard samples only.

SERIES III. March 4, 1966

Number of samples analyzed: Six (synthetic).

Participating laboratories:

1. American Oil Company
2. Cities Service Oil Company
3. City of Chicago, Bureau of Water, Dept. of Water and Sewers
4. Gary-Hobart Water Corporation
5. Great Lakes-Illinois River Basins Project
6. Indiana State Board of Health
7. Inland Steel Company
8. Lake Huron Program Office, GLIRBP
9. Metropolitan Sanitary District of Greater Chicago

Analysis date: March 4, 1966.

Conditions: The following conditions were stipulated by advance notice to the participating laboratories:

Distillation Method: Standard Methods, 12th Ed., pp. 186-193, with emphasis on the following points:

"Steaming out apparatus to ensure ammonia-free conditions - same as in previous series.

"Adjustment to pH 6.6 prior to adding buffer -

"previous series called for pH 7.0.

"Collection of distillate in 0.02N sulfuric acid - previous series called for 0.002N sulfuric acid.

"Concentration of distillate to 50 ml instead of 100 ml - as required in previous series."

Procedure for AutoAnalyzer remained unchanged from last Series.

March 17, 1966

Calumet Area Laboratory Directors met for the purpose of reviewing the results obtained from the March 4 Test Series III. The results from Series III showed a substantial improvement over Series II. From a review of these results, it was agreed that an additional study should be made; it was requested and agreed that a prescribed procedure for the ammonia nitrogen test be provided for use in future comparison tests. This was done as requested, with particular emphasis on distillation of standards in preparing calibration curve and volume of distillate.

SERIES IV. March 23, 1966

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Number of samples: Six.

Participating laboratories:

1. American Oil Company.
2. Cities Service Oil Company
3. City of Chicago, Bureau of Water, Dept. of Water and Sewers
4. Gary-Hobart Water Corporation
5. Great Lakes-Illinois River Basins Project
6. Indiana State Board of Health
7. Inland Steel Company
8. Lake Huron Program Office, GLIRBP
9. Lake Ontario Program Office, GLIRBP
10. Metropolitan Sanitary District of Greater Chicago
11. Robert A. Taft Sanitary Engineering Center

Conditions: "All laboratories are to follow the procedure exactly as outlined. For the first time conformity in procedure is insisted upon."

April 21, 1966

Calumet Area Laboratory Directors met to review latest results of Series IV. There were some laboratory difficulties which still presented a problem -- the obtaining of ammonia-free water, ammonia background of laboratory, collection of distillate in boric acid, and use of rubber stoppers. It was agreed that one more comparison series be carried out.

SERIES V. April 26, 1966

Number of samples: Four.

Participating laboratories:

1. American Oil Company
2. Cities Service Oil Company
3. City of Chicago, Bureau of Water, Dept of. Water and Sewers
4. Gary-Hobart Water Corporation
5. Great Lakes-Illinois River Basins Project
6. Indiana State Board of Health
7. Inland Steel Company
8. Lake Huron Program Office, GLIRBP
9. Lake Ontario Program Office, GLIRBP
10. Metropolitan Sanitary District of Greater Chicago
11. Robert A. Taft Sanitary Engineering Center

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Conditions: The procedure to be followed was the same as prescribed for the last series with no changes. Points emphasized: collecting 300 ml of distillate and distilling standards in preparation of a standard curve.

At the meeting of the Calumet Area Laboratory Directors May 19, 1966, for the purpose of reviewing recent comparison Series V for ammonia nitrogen, the Laboratory Directors unanimously decided that further testing would be of little value. Series V showed that when all laboratories followed the same procedure, most of the laboratories obtained an accuracy of ± 0.02 mg/l, or better, in analyzing standard samples containing 0.00 and 0.04 mg/l ammonia nitrogen.

The subject of direct nesslerization was again brought up and the opinion was expressed that this method should not be entirely excluded from the future thinking of the members of this group.

Problems which existed throughout the Series were as follows:

From the beginning of the Series there was a question of ammonia-free water and ammonia-free reagents (buffer and sulfuric acid). Ordinary distilled water was found to contain significant amounts of ammonia. Redistilled water, upon concentration, still contained some ammonia.

The best procedure for obtaining ammonia-free water was found to be the addition of sulfuric acid to the redistillation, if a carbon or ion-exchange column couldn't be attached to the still. Once the ammonia-free water was prepared, keeping it free from ammonia contamination was an important factor.

Clean glassware was imperative. Cleaning glassware with chromic acid solution and then rinsing with ammonia-free water was found to be the best preparation for glassware.

It was suggested that rubber stoppers be replaced with special neoprene stoppers since ammonia does adsorb to rubber.

This section on procedures indicates that with conformity of procedure, reliable results can be obtained.

The results of the above comparison series are discussed and summarized in detail in the next section of this report.

III. FINDINGS AND DISCUSSION

Distillation Method

As indicated in the preceding section, progressive improvement in agreement of results from the individual laboratories was realized in application of the distillation method. Uniform test procedures were not followed by all laboratories for the first three series and results were erratic. After uniform procedures were followed, the results were more consistent and gave better indications of the accuracy that can be achieved when the recommended procedure is carefully followed.

Tables 1a and 1b present individual laboratory average results chronologically and anonymously. When analyzing samples containing 0.00 mg/l of ammonia nitrogen, an accuracy of ± 0.04 mg/l (one standard deviation) was obtained in Series II, whereas in a repeat analysis in the last series, an accuracy of ± 0.02 mg/l was realized. The same improvement was noted when analyzing standard samples containing concentrations in the range of 0.02 to 0.05 mg/l. In general, the average values indicate a slight tendency to be on the high side in these determinations.

Even closer agreement was demonstrated when analyzing Lake Michigan samples from the City of Chicago and Gary-Hobart water intakes, where a precision of ± 0.04 mg/l was obtained in October 1965 (Series II), and in April 1966 the precision had improved to ± 0.01 mg/l.

Recoveries of known amounts of ammonia nitrogen by the distillation process are shown in Table 3. The precision and accuracy were in this instance, the same and was ± 0.02 mg/l for recoveries of 0.10 and 0.05 mg/l ammonia from Lake Michigan water. The precision and accuracy for recovery of 1.0 mg/l ammonia nitrogen from river water (collected from the Indiana Harbor Canal) was ± 0.29 mg/l.

AutoAnalyzer Method

From the inception of the studies, the AutoAnalyzer method provided results demonstrating precision and accuracy superior to those of the distillation method. These results are shown in Tables 2, 5 and 6. Precision and accuracy, in terms of one standard deviation for standard and lake samples, was most often ± 0.01 mg/l. For the recoveries of the known amounts (0.05, 0.10, and 1.0 mg/l) added to lake and river water, the accuracy was ± 0.01, ± 0.01, and ± 0.09 mg/l, respectively.

Data Evaluation

Figures 1 through 7 summarize the results from both methods in terms of deviation from the known amounts of ammonia nitrogen. The range of deviation from known amount and distribution of individual values are presented as percent of all determinations accruing from all participating laboratories. The reliability of the method as used in the various laboratories may, in this manner, be estimated. Approximately 32 to 96% of all the distillation determinations for standard samples ranging from 0.00 to 0.06 mg/1 are within ≤ 0.02 mg/1 (one standard deviation). It is to be noted that a significant percentage of AutoAnalyzer determinations showed no deviation at all from the known amounts (60 to 90%).

Forty-nine to 67% of all distillation results were within ≤ 0.02 mg/1 for standard samples in the range of 0.11-0.15 mg/1 ammonia nitrogen; 22-84% were within ≤ 0.04 for standard samples in the range of 0.30-0.38 mg/1 ammonia nitrogen; and 45-61% were within ≤ 0.08 mg/1 for standard samples containing 0.72-0.97 mg/1 ammonia nitrogen.

The findings are presented in further graphic detail in Figures 9 through 14, located in the Appendix in the form of probability curves for each sample in the entire study.

Laboratory Evaluation

Since the data are herein presented anonymously, a direct comparison of laboratory performance in using the distillation method is not possible. However, all laboratories, of course, did not show equal performance. As indicated in the Procedure Section, consistency of relative achievement was present at the beginning of these comparisons. Most of the laboratories did demonstrate that, with enough effort and special precautions, the data so generated might be considered as interchangeable if a standard deviation of $\nless$ 0.02 mg/l is allowable.

A statement by Mr. Dwight G. Ballinger, consultant to the Laboratory Directors, is quoted below:

> "Adequate data is lacking on the precision and accuracy of the ammonia nitrogen determination at concentrations below 0.1 mg/l. Standard Methods, Twelfth Edition (1965), indicates a reproducibility of 5% for the distillation procedure, but this figure was obtained at concentrations found in polluted waters.
>
> "In a recent study, Dr. David Jenkins, University of California, investigated ammonia nitrogen concentrations of approximately 0.03 mg/l in San Francisco Bay waters. Dr. Jenkins found that the standard deviation of the distillation-Nessler procedure, using 10 replicate determinations of the same sample, was $\nless$ 0.005 mg/l. Experience in

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"the Analytical Reference Service of the Taft Center indicates that a comparison of results between laboratories yields a deviation at least three times greater than the deviation within the single laboratory. Thus, an extrapolation of the Jenkins data suggests an interlaboratory comparison of approximately ± 0.02 mg/1 at the 0.03 mg/1 level.

"It should be noted that the University of California studies were conducted with 10 replicate determinations, in a very carefully controlled test. The results obtained are probably superior to those normally found in routine survey work.

"On the basis of the available information on the precision and accuracy of the ammonia nitrogen determination, it is my opinion that the values reported by the average laboratory may be expected to deviate from the true concentration by at least ± 0.02 mg/1 at ammonia nitrogen levels below 0.05 mg/1. However, in order to ensure the best possible results, only those laboratories demonstrating ability to meet this precision level should be included in a nutrient monitoring operation."

In conclusion, this section on procedure shows that good results can be attained in the distillation method for ammonia nitrogen, especially at the low levels encountered in Lake Michigan water, provided that: a great amount of care in preparation and skill in technique are exercised, and that there is strict adherence to the method outlined in Standard Methods with the modifications as described in the Appendix of this report.

IV. CONCLUSIONS AND RECOMMENDATIONS

1. This study indicated that an accuracy of ± 0.02 mg/1, expressed as one standard deviation, can be achieved when analyzing Lake Michigan open water, inshore, and harbor samples by distillation. When samples from the above waters are analyzed employing the AutoAnalyzer, an accuracy of ± 0.01 mg/1 can be achieved. The precision that can be obtained by distillation is ± 0.01 mg/1 (one standard deviation), and when employing the AutoAnalyzer, the precision is better than this value.

2. The above distillation results have been obtained by modifying the method for ammonia nitrogen, as given in Standard Methods, 12th Edition, to comply strictly with the procedure as presented in the Appendix of this report.

3. The AutoAnalyzer procedure was demonstrated to be superior (more accurate with greater precision) to the distillation procedure for the relatively uncontaminated lake waters.

4. Of the 11 participating laboratories, the majority was able to achieve the above accuracy using the distillation procedure. These results were not achieved on a routine basis, but under conditions requiring extraordinary care and precautions. Laboratories exposed to extreme air pollution problems, and those small laboratories where all analyses must be performed in one room, will most likely not be able to obtain these accuracies at the concentrations under investigation.

5. The limit of detectability using the modified distillation procedure, as presented herein for the detection of ammonia nitrogen in Lake Michigan waters, appears to be 0.02 mg/1. With the AutoAnalyzer, the limit appears to be 0.01 mg/1. It is possible that the sensitivity of the distillation procedure can be improved. However, such a possibility can be verified only through further applied research.

6. Only those results from laboratories showing the continuing capability to analyze at an accuracy of ± 0.02 mg/1, or better, should be accepted in a monitoring operation

when analyzing for ammonia nitrogen levels below 0.06 mg/1.

7. Historic data reporting ammonia nitrogen levels below 0.1 mg/1 should be evaluated with extreme caution. There appears to be no practical way to develop a correction factor to apply to the latter data which would provide acceptable correlations in the lower concentration ranges.

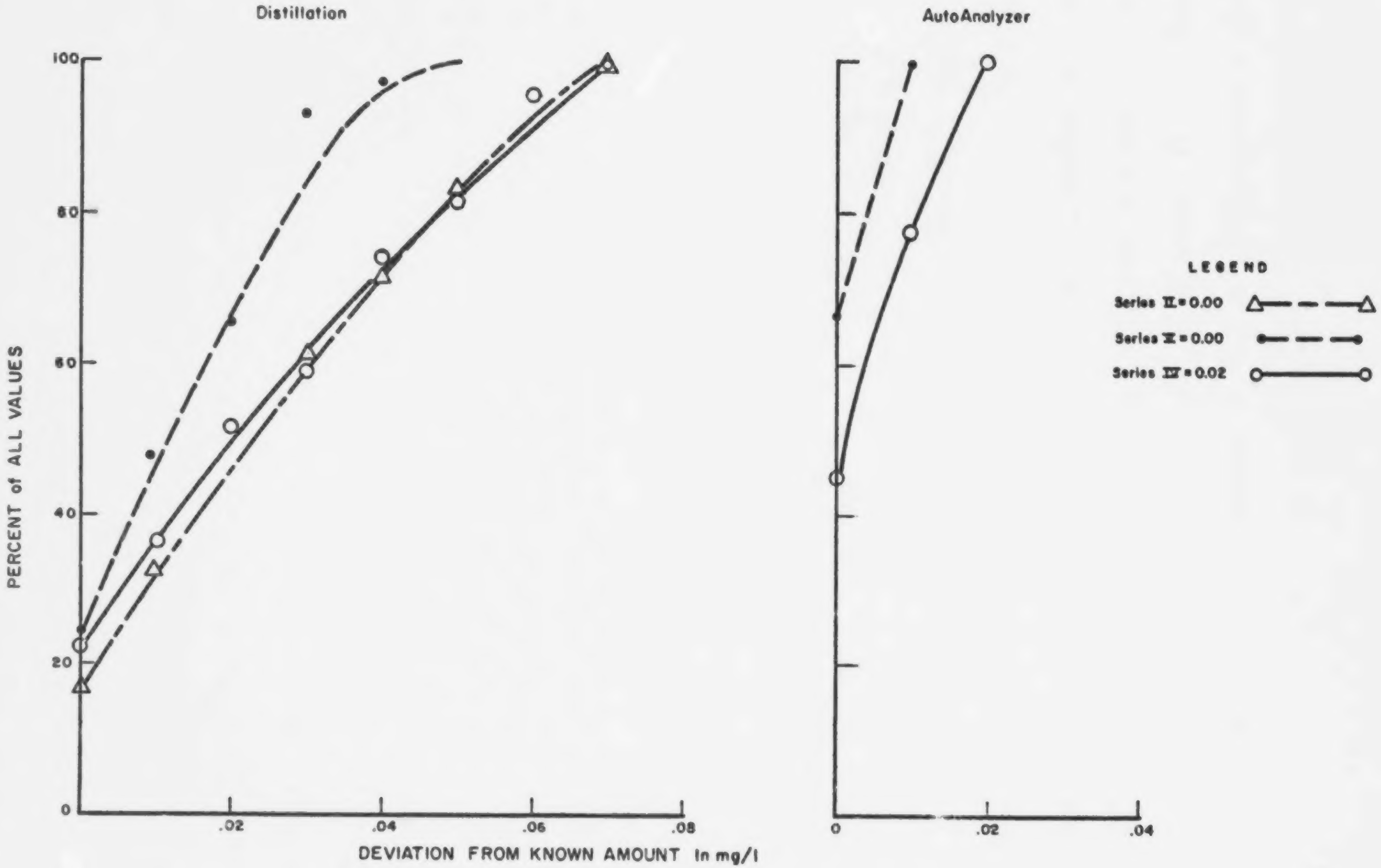
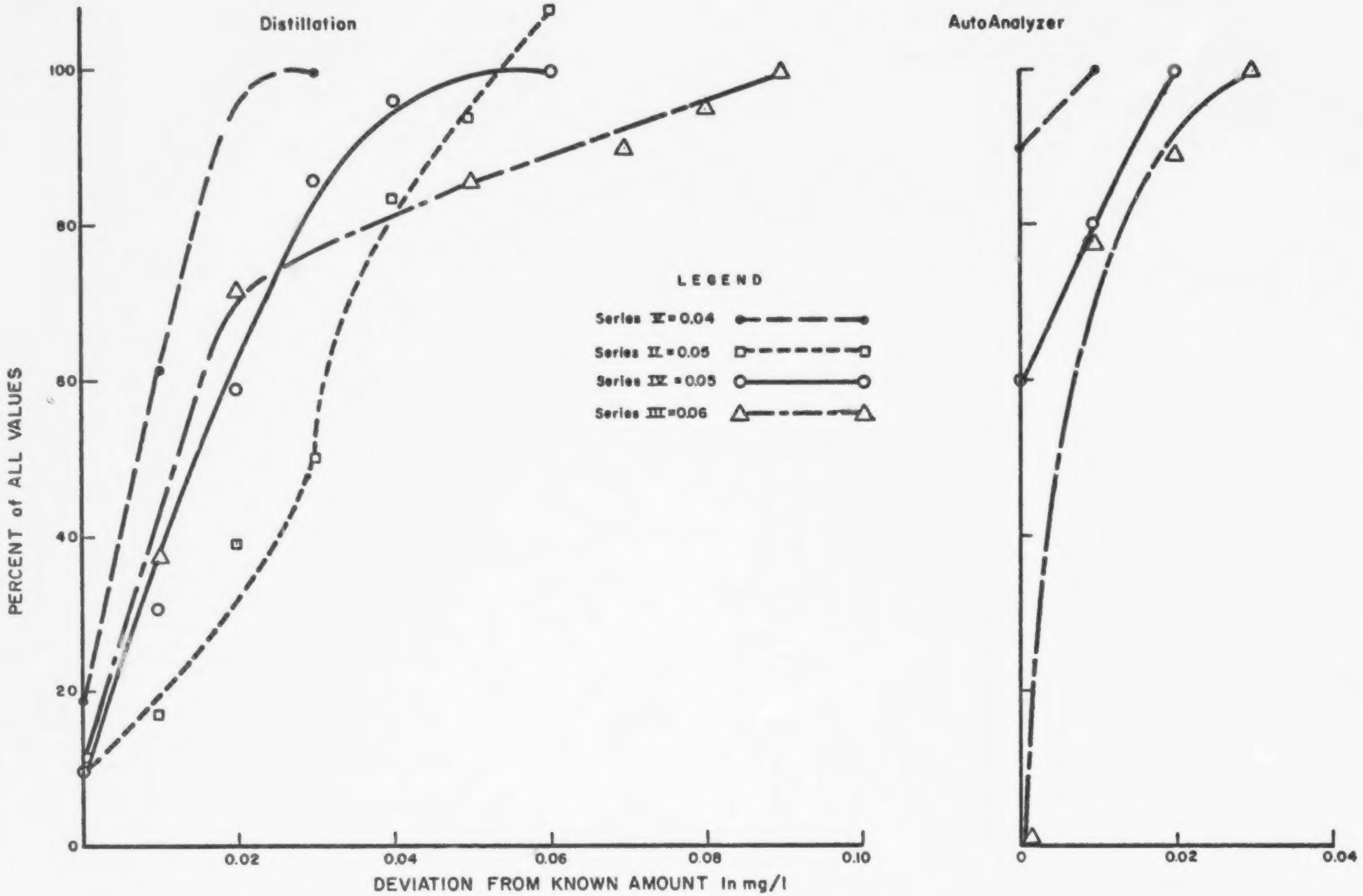


FIGURE I

CALUMET AREA-LAKE MICHIGAN COMPARISON SAMPLES
Percent Distribution of All Ammonia Nitrogen Determinations, 0.00 and 0.02 mg/l



CALUMET AREA-LAKE MICHIGAN COMPARISON SAMPLES
Percent Distribution of All Ammonia Nitrogen Determinations, 0.04, 0.05 and 0.06mg/l

FIGURE 2

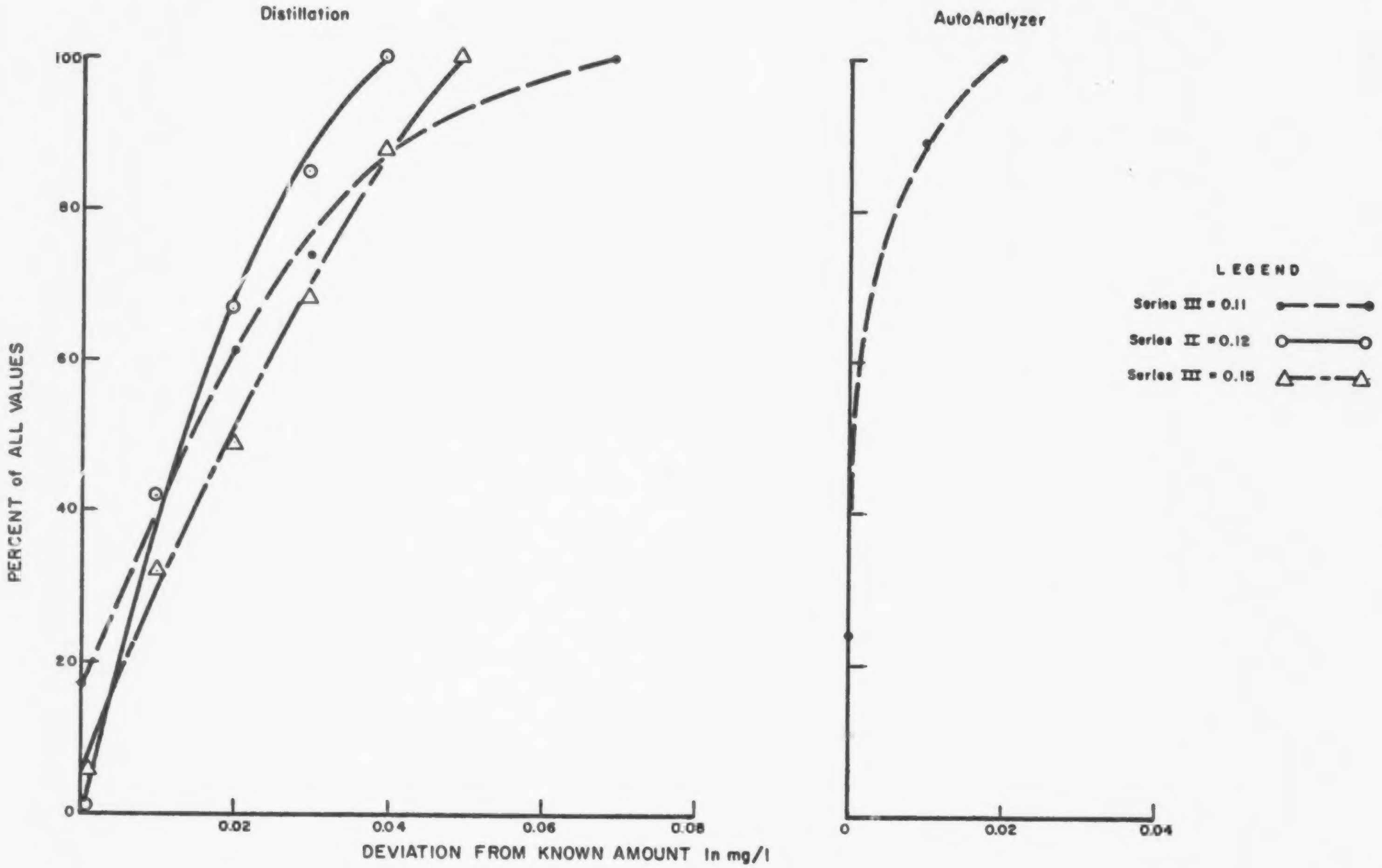
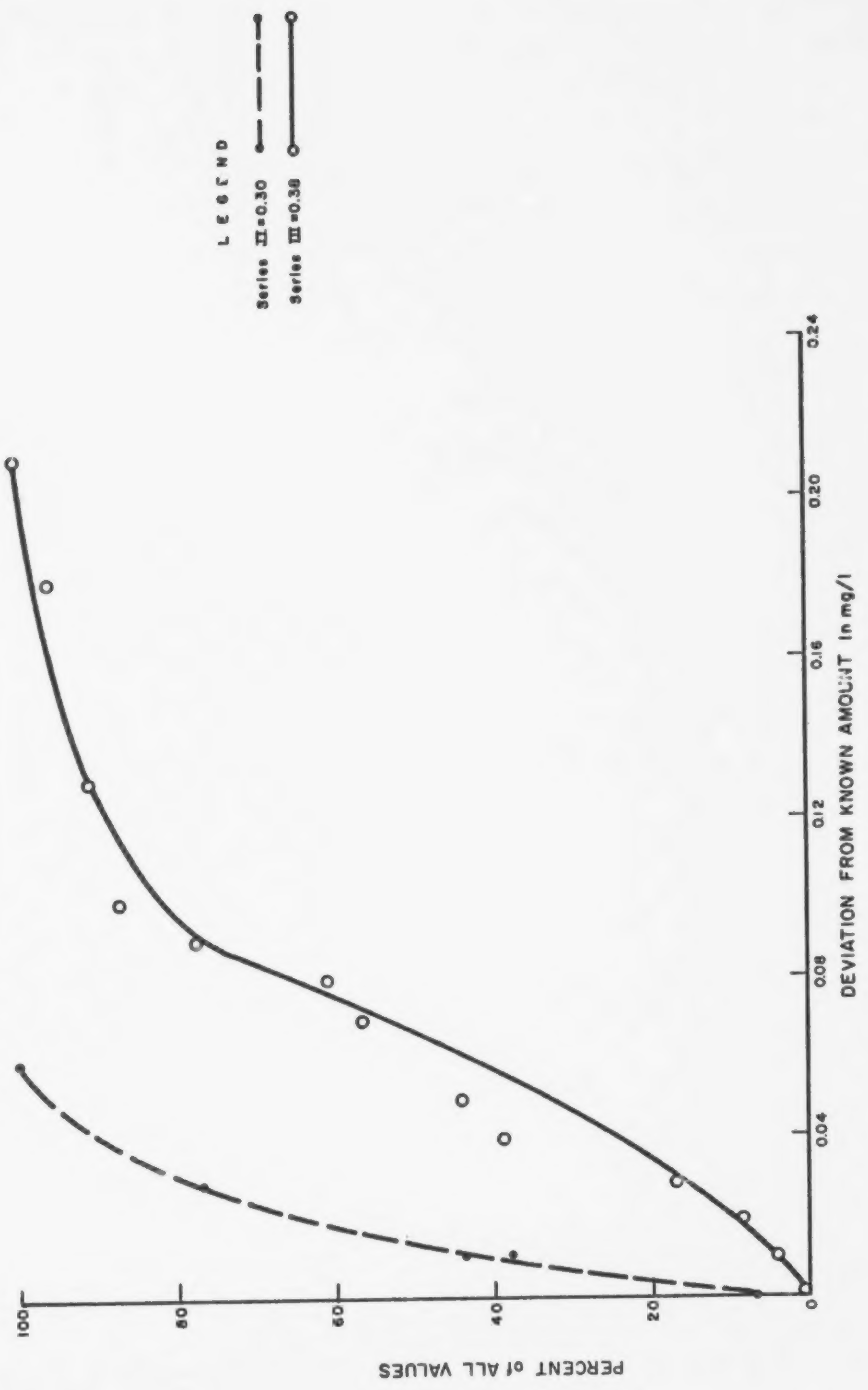


FIGURE 3

CALUMET AREA-LAKE MICHIGAN COMPARISON SAMPLES

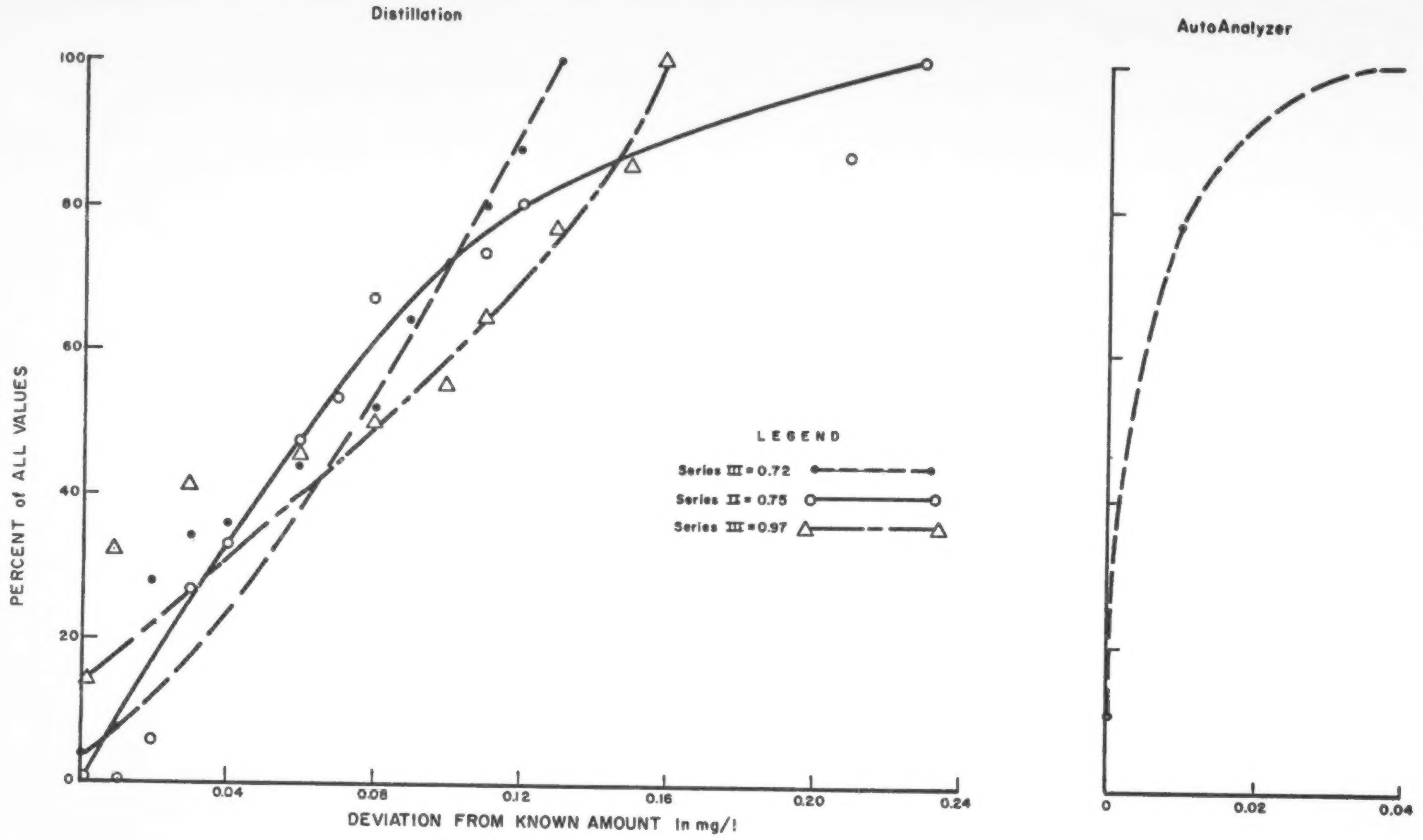
Percent Distribution of All Ammonia Nitrogen Determinations, 0.11, 0.12 and 0.15 mg/l



CALUMET AREA-LAKE MICHIGAN COMPARISON SAMPLES

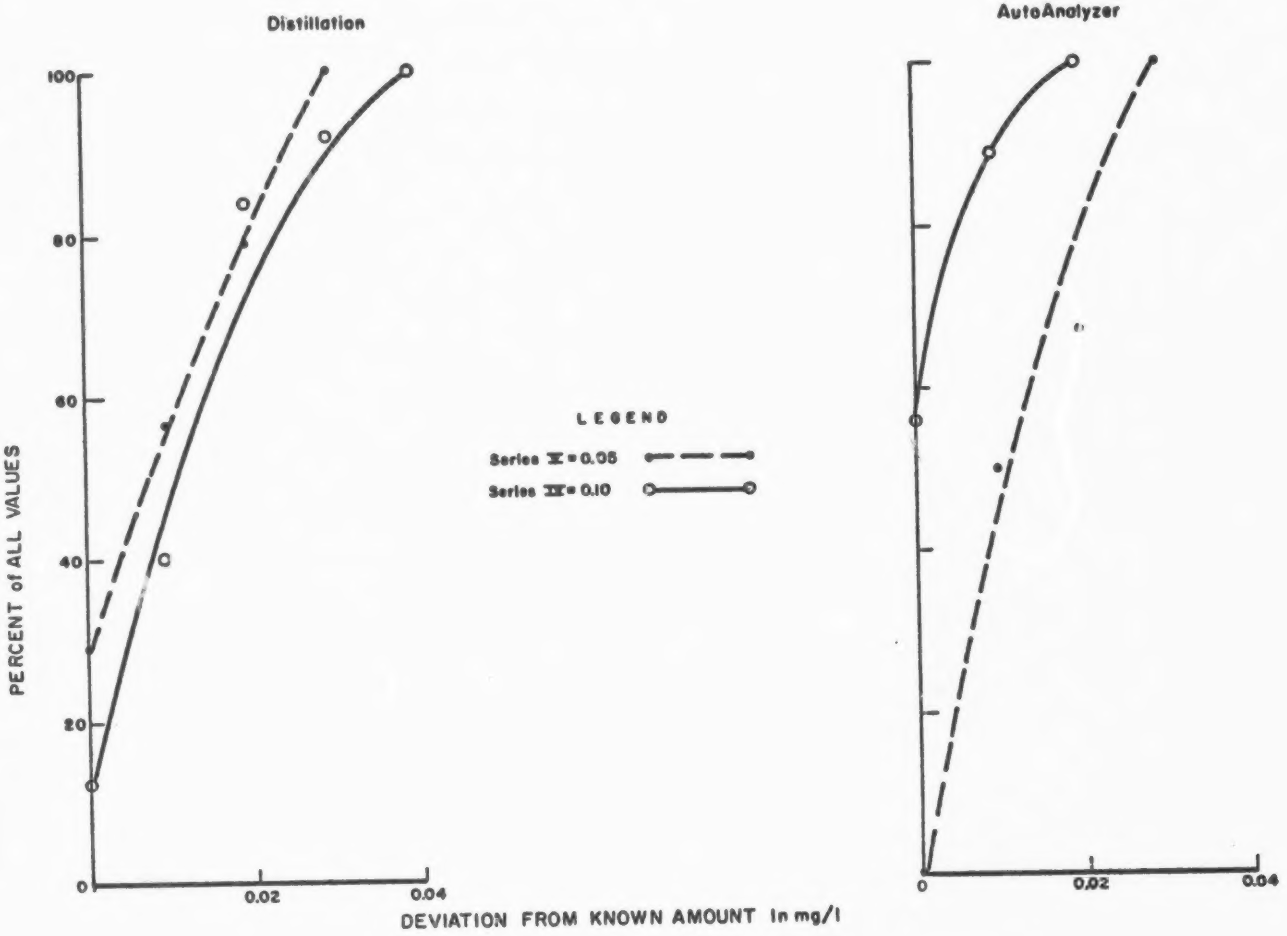
Percent Distribution of All Ammonia Nitrogen Determinations, 0.30 and 0.38 mg/l

FIGURE 4



CALUMET AREA-LAKE MICHIGAN COMPARISON SAMPLES
Percent Distribution of All Ammonia Nitrogen Determinations, 0.72, 0.75 and 0.97 mg/l

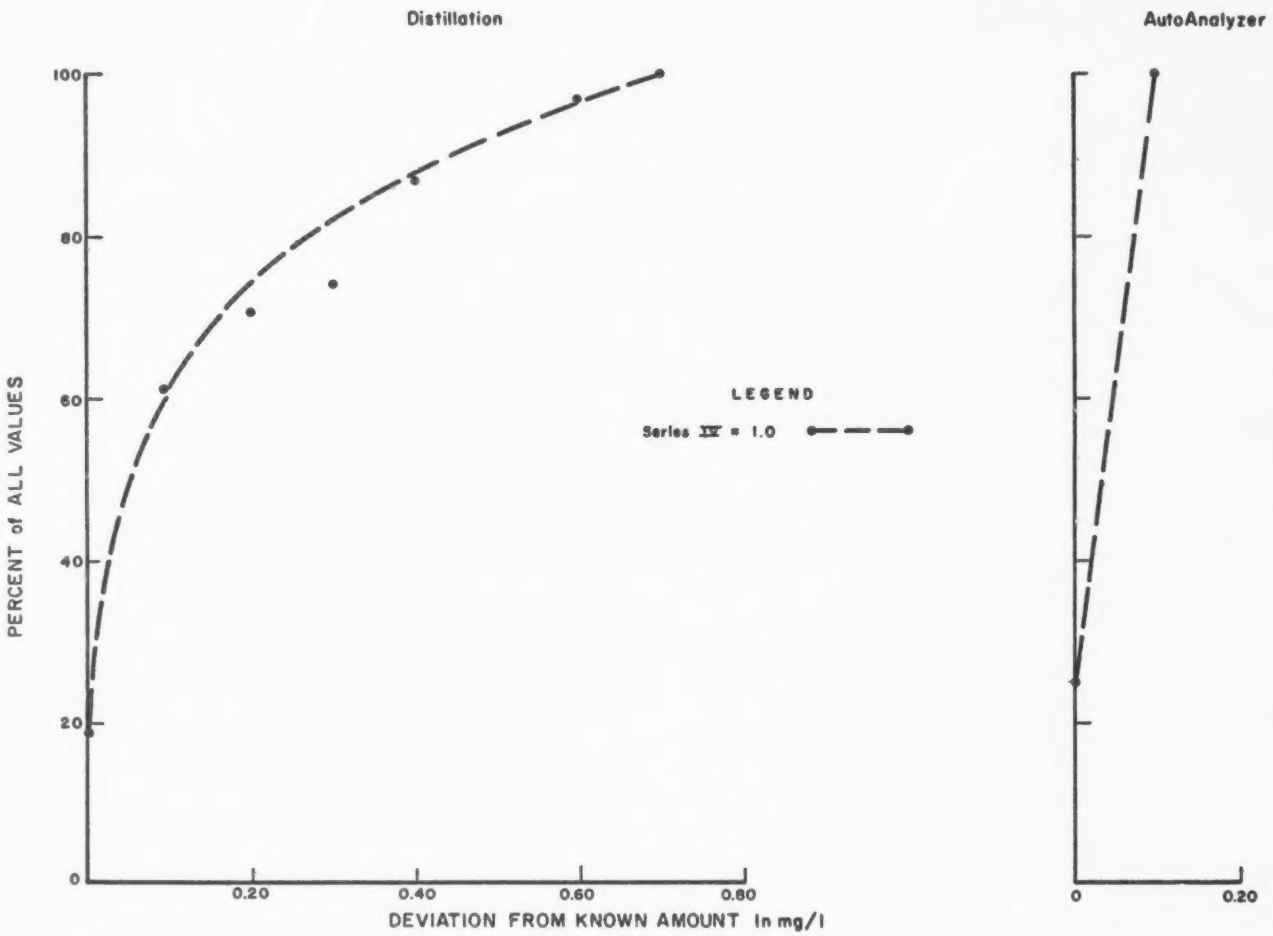
FIGURE 5



CALUMET AREA-LAKE MICHIGAN COMPARISON SAMPLES

Ammonia Nitrogen Recoveries from Spiked Lake Samples by Distillation and Auto Analyzer. 0.5 and 0.10 mg/l

FIGURE 6



CALUMET AREA-LAKE MICHIGAN COMPARISON SAMPLES
Ammonia Nitrogen Recoveries from River Samples by Distillation and AutoAnalyzer 1.0 mg/l

FIGURE 7

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APPENDIX

ANALYTICAL PROCEDURAL DETAILS FOR THE ANALYSIS OF AMMONIA NITROGEN

The sodium phenate method, using the AutoAnalyzer, is recommended by the authors of this report for the analysis of ammonia nitrogen, as are the methods found in the 12th Edition of Standard Methods for the Examination of Water and Wastewater, in particular the distillation-nesslerization method (pages 186 through 194), with the modifications presented herein.

1. AutoAnalyzer Procedure - Ammonia Nitrogen

   Sodium Phenate Method:

   Reagents:

   1. Alkaline phenol solution: Dissolve 83 g phenol in 200 ml of distilled water at room temperature and add 180 ml of 5-N-sodium hydroxide solution to the phenol solution. Make up the volume to 1000 ml witn distilled water and store in an

amber bottle; keep in refrigerator when not in use. If the sodium phenate turns dark, discard it.

2. Sodium hypochlorite solution: 5% available chlorine.
3. Sodium nitroprusside, 0.005%: Dissolve 1 g in 100 ml of distilled water. Dilute 5 ml of this solution to 1000 ml with distilled water. Store in refrigerator at 4°C.
4. Standards: Dissolve 3.819 g of ammonium chloride in ammonia-free water, add 0.8 ml conc. H_2SO_4 and make up to 1000 ml. This solution contains 1 mg of nitrogen per ml. Appropriate standards are prepared by diluting this stock solution.

Procedure:

1. Set up the analytical system in accordance with the attached flow diagram. Allow 30 minutes for instrument to warm up and establish a base line using distilled water as the sample.
2. Filter turbid samples through a pledget of cotton or membrane filter, discarding the first 10 ml of filtrate.

3. Arrange five standards, ranging from 0-0.75 mg/1, and samples on the turntable with a single distilled water wash between each sample and standard.
4. There should be a set of standards placed in each row.
5. Set the cycle time at two minutes and the sample time at one minute and 59 seconds.
6. All readings made at a magnification of 2X when the NH_3-N levels are very low, and 1X at higher levels.

2. Distillation Procedure - Ammonia Nitrogen

Of all the methods listed in Standard Methods, 12th Edition, the distillation method is preferred for the determination of ammonia nitrogen, in trace or appreciable amounts, especially when interferences of any nature are suspected. The distillates may be titrated*or nesslerized.

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* If titration is used, collect in boric acid as given in Standard Methods, p. 191, Sec. 4.4 and p. 404, Sec. 4.3.

Nesslerization of the distillate is the method of choice for distillates containing 1 mg or less of ammonia nitrogen. (In the absence of interfering substances, the direct nesslerization method may be used but this method is reserved for samples containing ammonia nitrogen in excess of 0.2 mg/1.)

Nesslerization Method:

Apparatus:

1. All-glass distilling apparatus with 800-2000 ml capacity flask.
2. Spectrophotometer or filter photometer for use at 425 mμ, and providing a light path of 1 cm or longer.
3. Nessler tubes 50 ml tall form.

Reagents:

All reagents prepared in ammonia-free distilled water.

1. Ammonia-free water may be prepared by redistilling distilled water containing 1 ml of concentrated sulfuric acid per liter, or as stated in Standard Methods, p. 189.
2. Phosphate buffer solution, p. 189-190.

3. Stock ammonium solution, p. 190.
4. Standard ammonium solution, p. 190.
5. Neutralization reagent, 1.0N sodium hydroxide, p. 190.
6. Neutralization reagent 1.0N sulfuric acid, p. 190.
7. Nessler reagent, p. 190.
8. Rochelle salt solution, p. 194.
9. Sulfuric acid 0.02N, p. 50.
10. Boric acid solution, p. 190.

Procedure:

1. Preparation of equipment: Add 500 ml of distilled water, 10 ml of phosphate buffer solution, and a few boiling chips to a 800 ml flask. Steam out the distillation apparatus until the distillate shows no trace of ammonia, p. 190.
2. Sample preparation: Use 500 ml of sample. Neutralize to a pH of about 6.6 using a pH meter for the measurement. Add 10 ml of the phosphate buffer, mix and check the pH which should now be 7.4. If it is not, add another 10 ml of the buffer solution and again check the pH, p. 190.

Distillation:

Distill over 300 ml into a 500 ml Erlenmeyer flask containing 50 ml of 0.02N sulfuric acid for nesslerization (or 50 ml 2% boric acid if titration is used). Distill at the rate of 6-10 ml/min. Lower the collected distillate free of contact with the delivery tube, and continue distillation during the last minute or two to cleanse the condenser and delivery tube.

Preliminary nesslerization:

Nesslerize a 50 ml portion of the distillate to determine if the concentration of ammonia in the distillate is in the satisfactory reading range for the colorimetric equipment used. For example, for a Spectronic 20 with a 1 inch cell, the satisfactory range is 0.10 to 1.4 mg/l. If the concentration is below 0.10 mg/l, the ammonia in the distillate should be concentrated by boiling. If the ammonia nitrogen is above 1.0 mg/l, the titrimetric method may be employed for measuring the ammonia in the distillate, or by nesslerization of a suitable aliquot.

Concentration of ammonia in the distillate:

Since the distillate is in the presence of acid (0.02N sulfuric acid) it may be boiled with no loss of ammonia.

1. Add boiling chips to the flask and boil on a hot plate to a volume of about 100 or 50 ml depending upon results from the preliminary nesslerization.

2. If the concentration of ammonia is less than 0.10 mg/1, the sample should be concentrated by evaporation. Transfer to 50 ml nessler tubes and bring the volume up to the 50 ml mark with ammonia-free water. The concentration factor in this case is 500/50 or 10.

3. If the concentration of ammonia nitrogen in the distillate is in the satisfactory range (0.10 to 1.4 mg/1) the concentration factor is $\frac{500}{300 + 50}$ or 1.43.

4. To each 50 ml sample or aliquot in the nessler tubes, add 1.0 ml of nessler reagent and mix by inverting the tube six times. Allow for color development at least 10 minutes, but not more than 20 minutes if the ammonia nitrogen is very low, but in any event run the samples and the standards the same length of time. Read at 425 mμ wavelength. The occasional formation of cloudiness following nesslerization may be

prevented by the use of two drops of Rochelle salt solution (Standard Methods, p. 189).

Preparation of standard curve:

The standard curve should be prepared under the same conditions as the samples. The blank (reagent blank) and the appropriate aliquot of standards - diluted to 500 ml each - are distilled in the same manner as the samples. The 300 ml distillate and 50 ml of 0.02 N sulfuric acid are brought up to the 500 ml volume before taking the 50 ml portion for nesslerization. The phosphate buffer, Rochelle salt solution, and nessler reagent are used as for the samples.

3. Sample Preparation and Collection

Several NH_3-N standards were prepared by the Great Lakes-Illinois River Basins Project and Indiana State Board of Health. Standards were prepared from anhydrous ammonium chloride dried at 100°C and dissolved in ammonia-free water. Ammonia-free water was prepared by redistilling distilled water containing sulfuric acid.

Lake samples were collected from the water intakes of the Gary-Hobart Water Corporation and Chicago's Central

District Filtration Plant. These samples were collected in three five-gallon carboys and then blended in a small drum or tank in order to obtain a homogeneous sample. One-half gallon samples were drawn off for the 11 laboratories and the remainder of the sample was spiked with the standard NH_3-N solution. A second set of 11 half-gallon samples were drawn off for the participating laboratories.

River samples were collected from Indiana Harbor Canal at 151st Street. These samples were collected and prepared in the same manner as the lake samples. All samples were preserved with 0.8 ml of conc. H_2SO_4 per liter.

4. Analysis of Data

The data were analyzed according to the method of least square to obtain one and two standard deviations. A line of best fit was plotted on probability paper. The slope of this line was based on one standard deviation: the mean (or known) value, plus and minus 34 percent, plotted at 16 and 84 percent on the abscissa.

The standard deviations were plotted in relation to the known amount of ammonia nitrogen, or in relation to the mean, in the case of lake and river samples. The standard deviations are indicated by broken lines and the known amounts or means are indicated by a solid line.

Probability curves like those shown in Figures 9-14 were prepared for each individual sample.